82-2P
May 1, 1958

Hydroptic-6A

SIP

8-28/117

SOCIÉTÉ GENEVOISE
D'INSTRUMENTS DE PHYSIQUE

87/14P

Hydroptic-6A

available with Automatic Repeating Device **DIR**

Main Features:

Accuracy Guaranteed

- Hand scraped guide ways optically checked
- Steel standard scales of SIP accuracy
- Optical coordinate settings on projection screens

Exceptional Productivity

- New powerful spindle head with 8 HP driving motor
- Tools designed for rapid stock removal
- Unproductive times reduced to a minimum

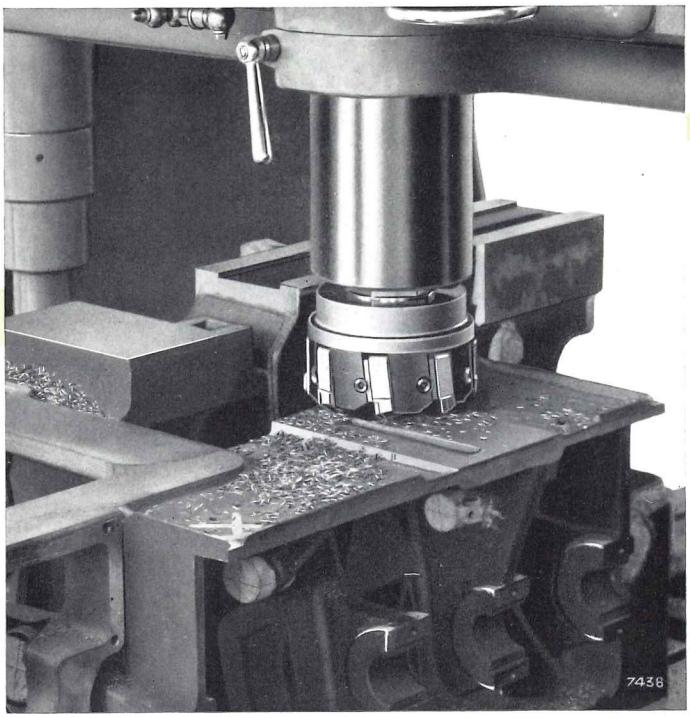
Rugged Construction

- Planer-type design ensuring maximum rigidity
- Spindle running in exceptionally rigid and precise SIP taper roller bearings
- Spindle head saddle of great width, travelling on rigid cross-rail

SIP

Geneva • Switzerland

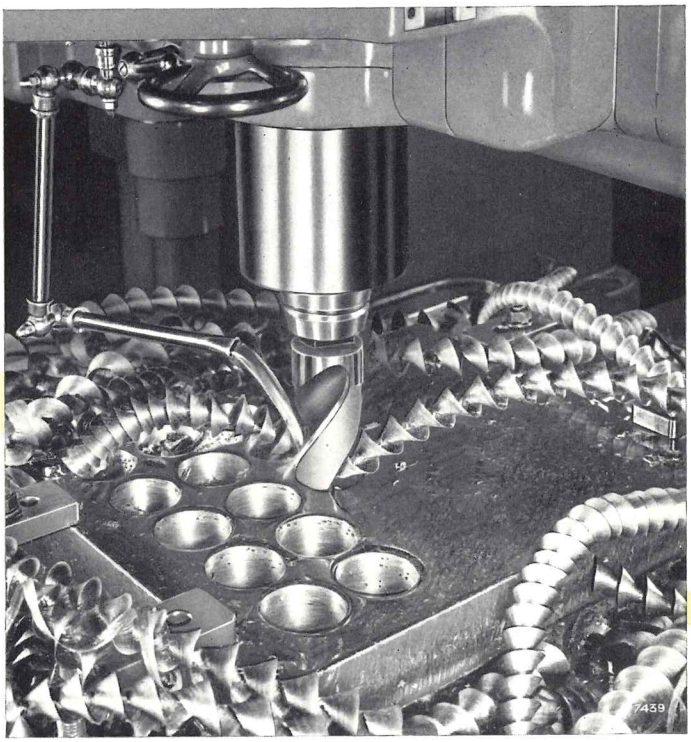
Machine Tool Show
Philadelphia, Pa
May 1st, 1958
FdH



Milling the bed of an automatic lathe

Applications

Drilling holes $2^{3}/_{8}$ in. (60 mm.) dia. in steel from the solid



Automatic Coordinate Repetition

Special accessory supplied to order

- Easy and rapid recording (saving time even for two or three pieces)
- High precision automatic settings of table and spindle head saddle
- Visual check of settings on screens and micrometer dials always possible

Working Capacity

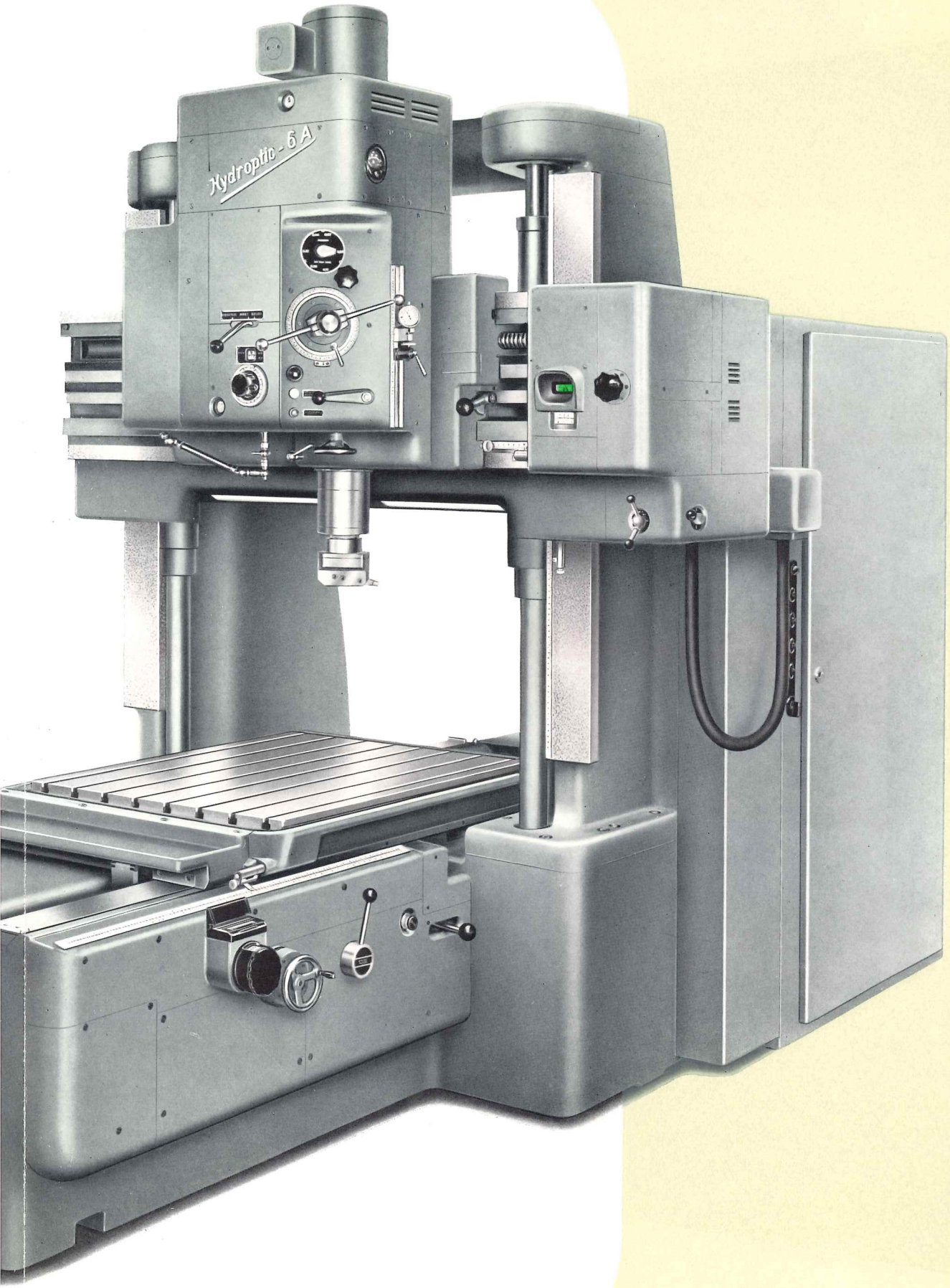
- Working range in horizontal plane : 40 by 28 in. (1000 by 700 mm.)
- Maximum free distance from spindle end to table top : 39 1/4 in. (1000 mm.)
- Vertical traverse of spindle (depth of boring) : 12 in. (300 mm.)

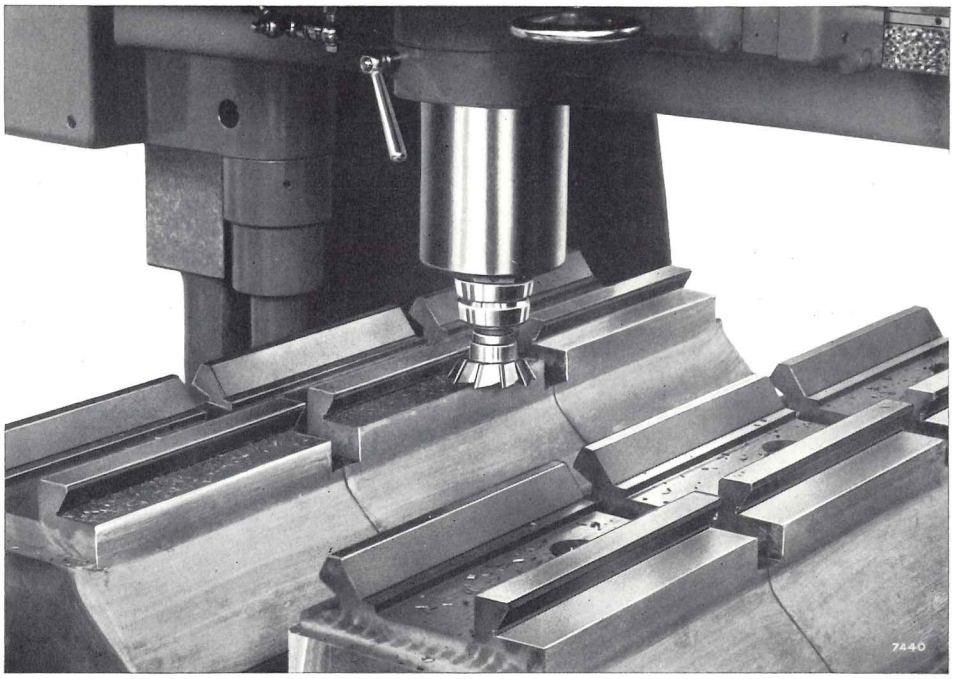
Speed of Operation

- All controls within easy reach of the operator
- Preselection of the spindle speeds
- Automatic tool clamping and releasing
- Rapid power traverse of table and spindle head
- Stepless hydraulic table feeds
- Power traverse and automatic locking of cross-rail
- Centralized lubrication controlled by single lever

Recognized for superiority in

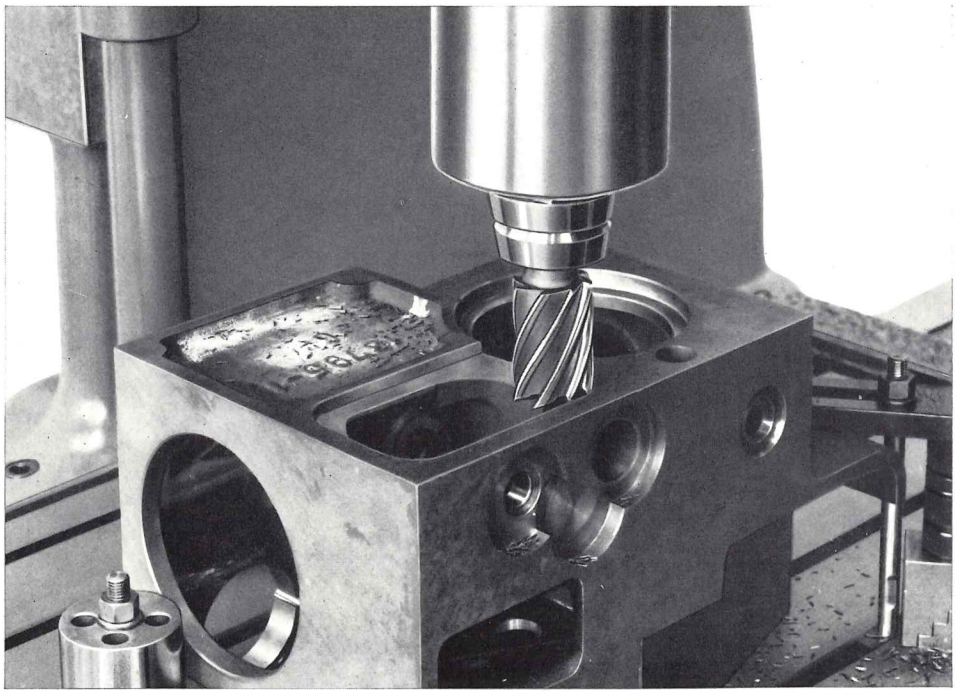
Speed
Power
Precision
Reliability

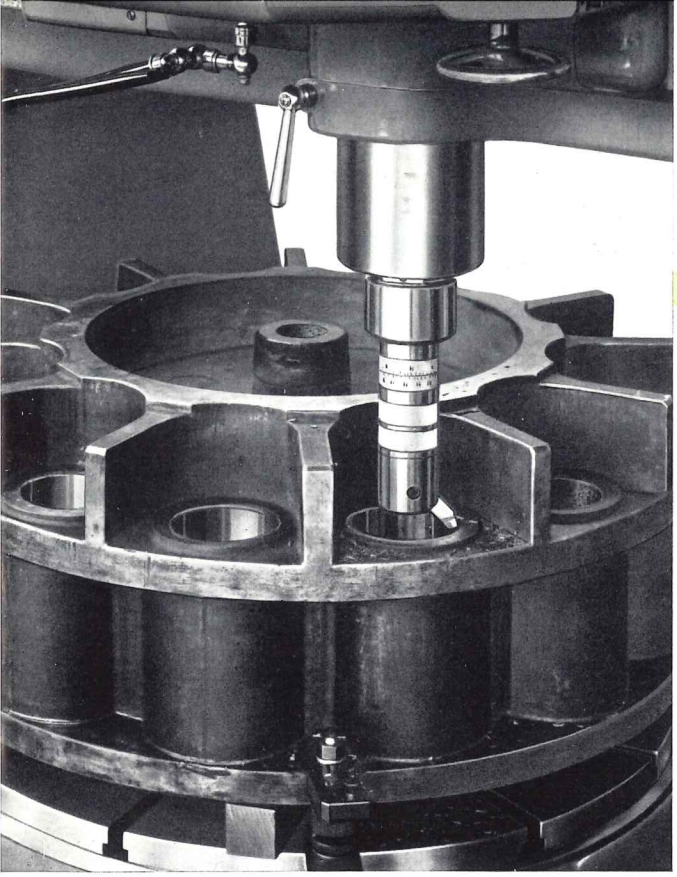

Hydroptic - 6A



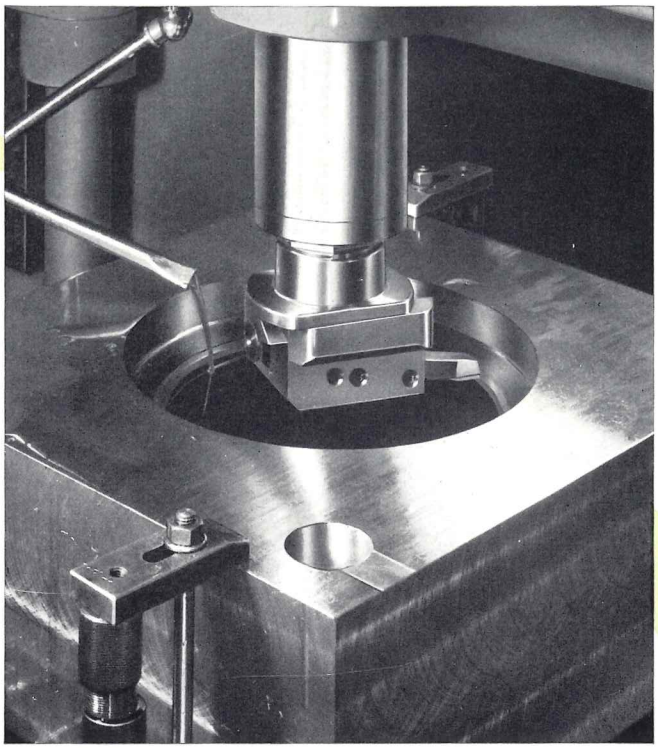
Milling guide ways in batch production

Milling the spindle head of a precision machine tool





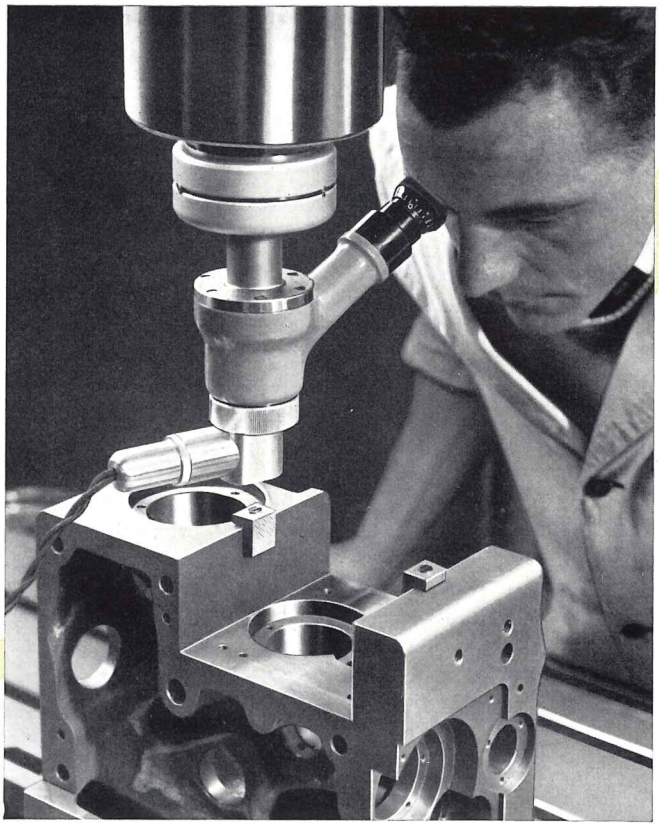
Boring a large circular jig



Boring a steel mould

... and even **Final inspection**

Facing operation, following boring



The Foundation of SIP Precision

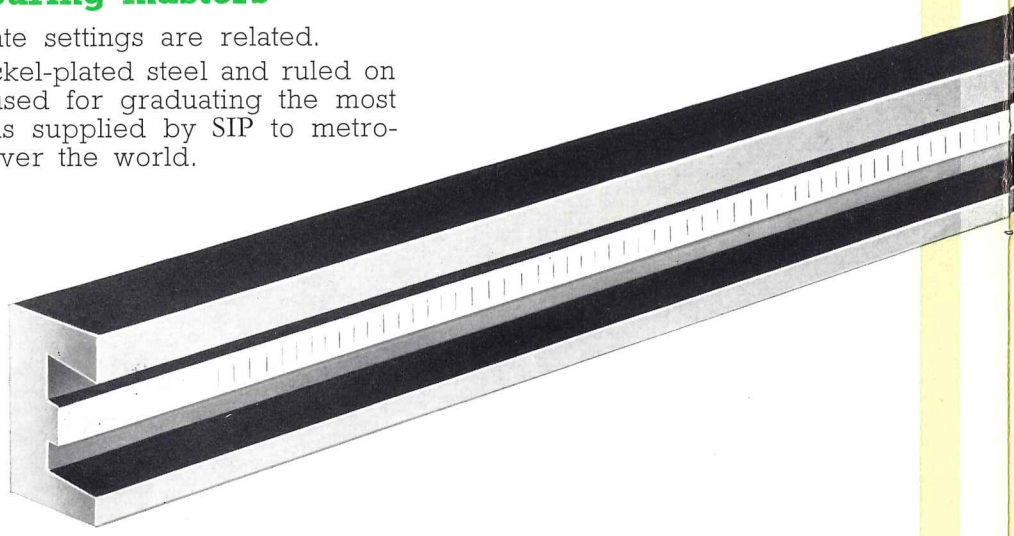
1 The standard scales

built into the work-table and the spindle head saddle and which constitute the

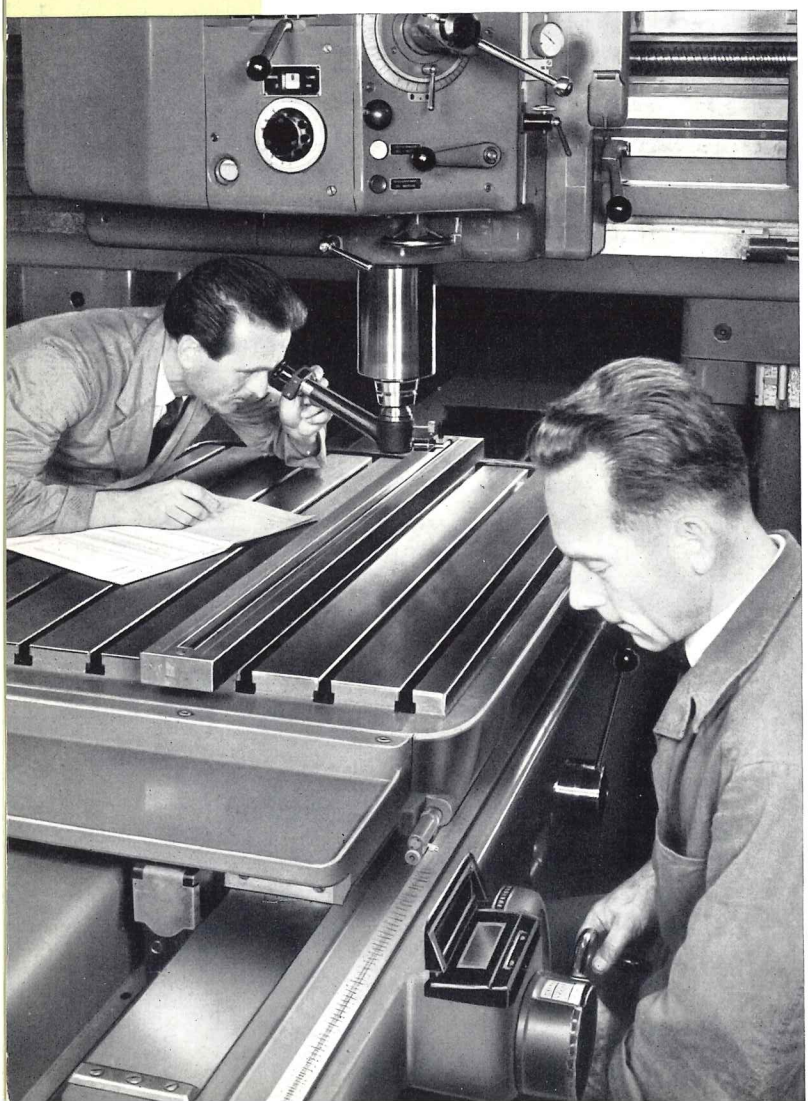
two basic measuring masters

to which all coordinate settings are related.

They are made of nickel-plated steel and ruled on the same machines used for graduating the most precise line standards supplied by SIP to metrological institutes all over the world.



Testing the accuracy of the table displacements with reference to a line standard



BUREAU INTERNATIONAL
DES
POIDS & MESURES

PAVILLON DE BRETEUIL
SÈVRES (S.-&-O.) FRANCE
TÉL.: OBS 00-52

UNITED STATES DEPARTMENT OF COMMERCE
WASHINGTON

National Bureau of Standards

Certificate

FOR

40-inch Steel Bar

Maker: Société Genevoise d'Instruments de Physique.
Maker's No. 2850

Submitted by

Société Genevoise d'Instruments de Physique,
Geneva, Switzerland.

This bar has been compared with the standards of the United States, and a calibration has been made of the one-inch sub-intervals. The results obtained are as follows:

Length of the interval from the zero to the 40-inch line at 20° centigrade, with the bar supported at the points of Bessel:

40.00001 inches.

The observations were made at a mean temperature of 20.04° centigrade and in reducing to 20° centigrade, the coefficient of linear expansion of 0.0000115 per degree centigrade was used.

Calibration of Sub-intervals.
Length of sub-intervals at 20° centigrade.

Interval (inches)	Length (inches)	Interval (inches)	Length (inches)
(0 to 1)	1.00000	(0 to 21)	20.99996
(0 to 2)	2.00001	(0 to 22)	21.99997
(0 to 3)	3.00003	(0 to 23)	22.99997
(0 to 4)	4.00003	(0 to 24)	23.99997
(0 to 5)	5.00002	(0 to 25)	24.99998
(0 to 6)	6.00001	(0 to 26)	25.99999
(0 to 7)	6.99998	(0 to 27)	26.99998
(0 to 8)	8.00001	(0 to 28)	27.99997
(0 to 9)	8.99997	(0 to 29)	28.99998
(0 to 10)	9.99997	(0 to 30)	29.99997
(0 to 11)	10.99999	(0 to 31)	30.99997
(0 to 12)	11.99998	(0 to 32)	31.99996
(0 to 13)	12.99999	(0 to 33)	32.99998
(0 to 14)	14.00000	(0 to 34)	33.99999
(0 to 15)	14.99997	(0 to 35)	34.99999
(0 to 16)	15.99997	(0 to 36)	35.99998
(0 to 17)	16.99998	(0 to 37)	37.00000
(0 to 18)	17.99996	(0 to 38)	38.00002
(0 to 19)	18.99996	(0 to 39)	38.99998
(0 to 20)	19.99995	(0 to 40)	40.00001

Test No. 2.4/125714

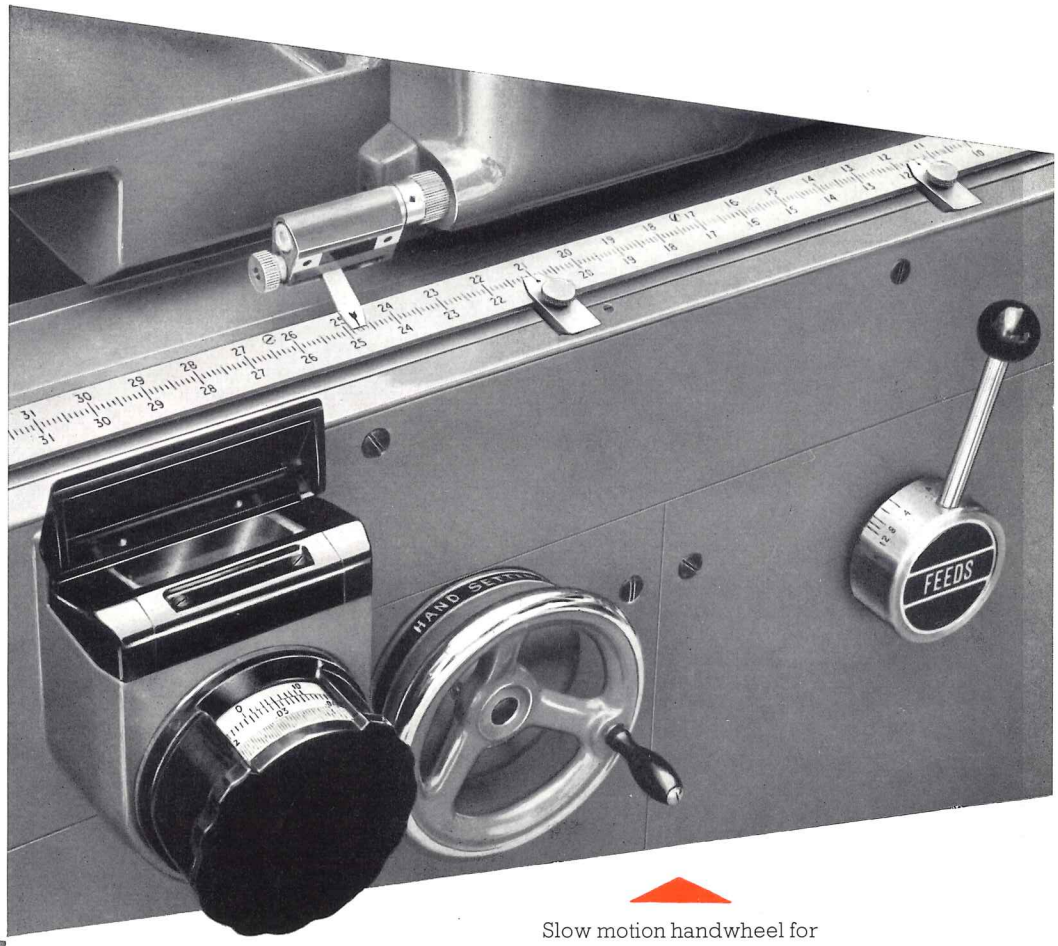
SIP line standards are the basic masters used by the International Bureau of Weights and Measures and most National Metrological Institutes.

2 The optical measuring system

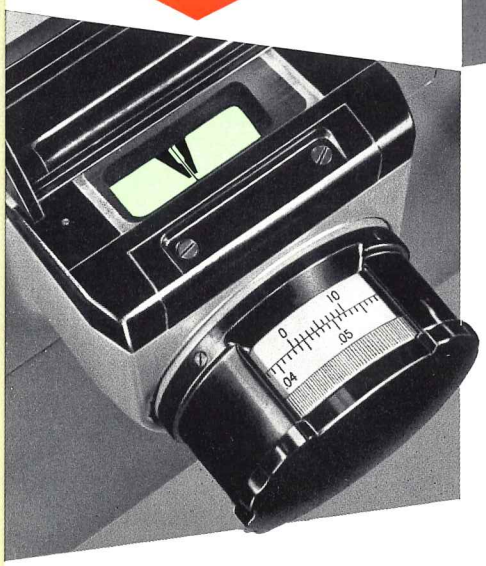
External scale and adjustable index marks for approximate positioning to 0.1 in. (1 mm.). Adjusting range of table index : 4 in. (100 mm.).

Micrometer head reading to 0.0001 in. (0.001 mm.).

Projection screen with setting indexes



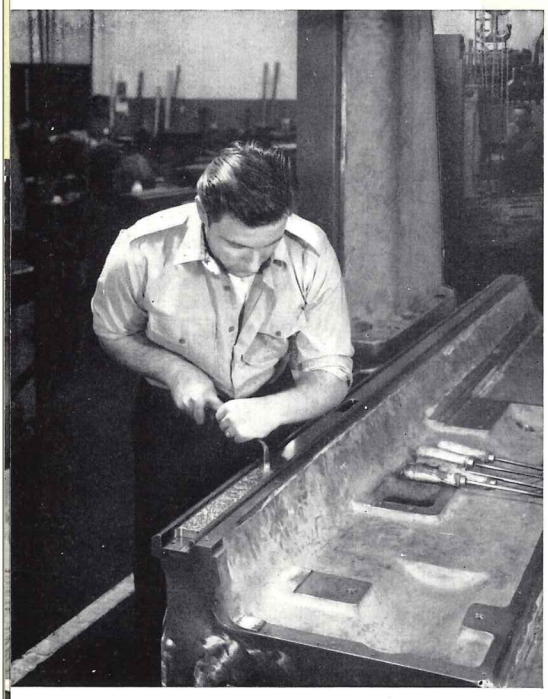
Slow motion handwheel for accurate table positioning



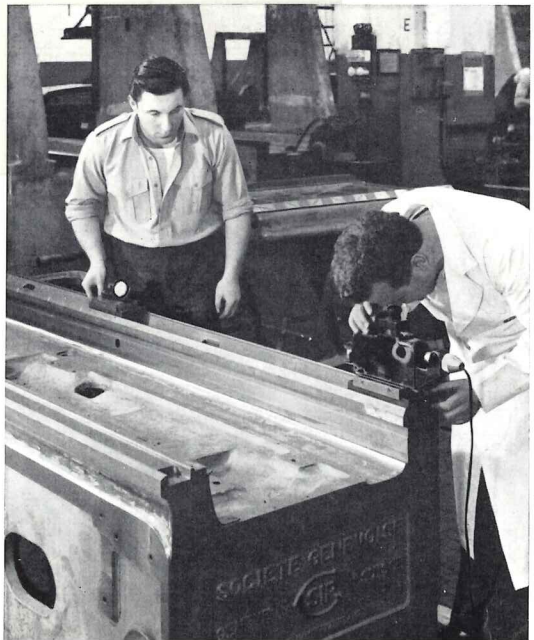
Easy and rapid settings **on projection screens**
Convenient readings **on wide dials**

The SIP measuring system, absolutely free from wear and mechanical stresses affords full assurance that the inherent precision of the standard scales will be retained indefinitely even under most exacting working conditions.

3 The planer-type design



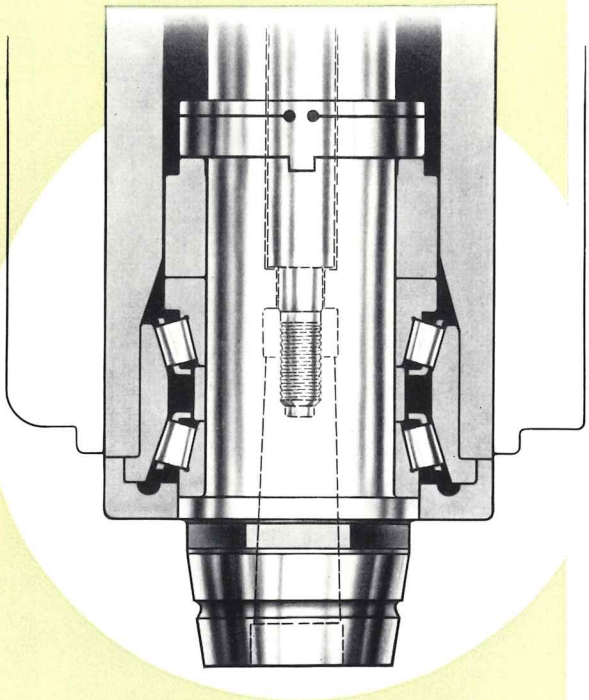
with rigid frame

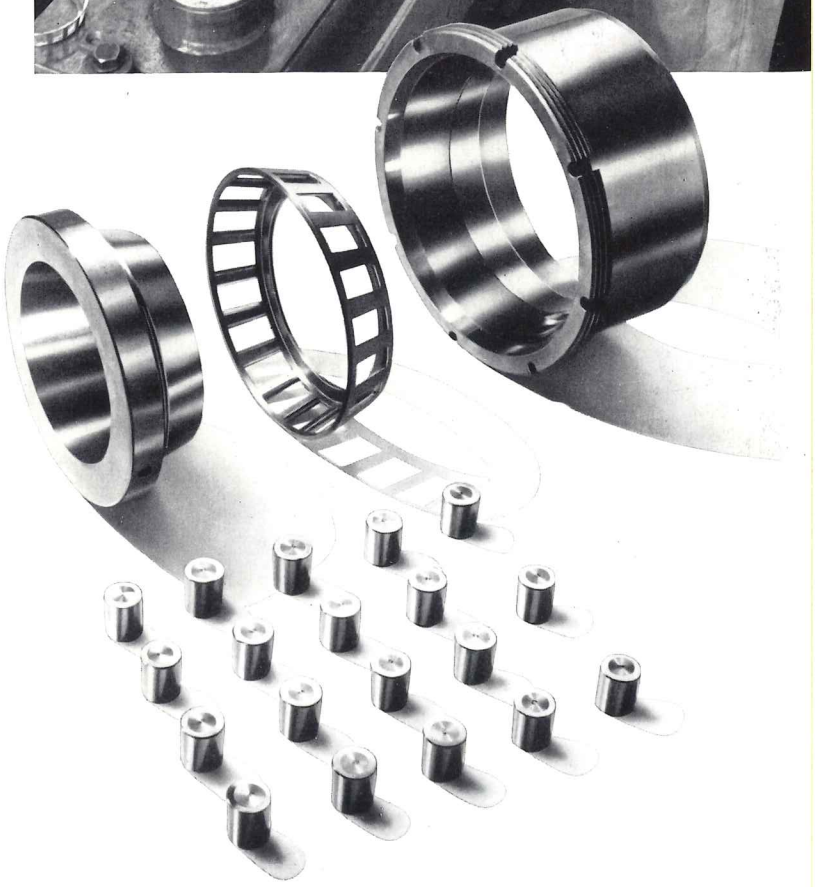


Hand scraped guide ways

optically checked to SIP standards of accuracy

4 The heavy duty spindle assembly





Spindle running in specially dimensioned

taper roller bearings

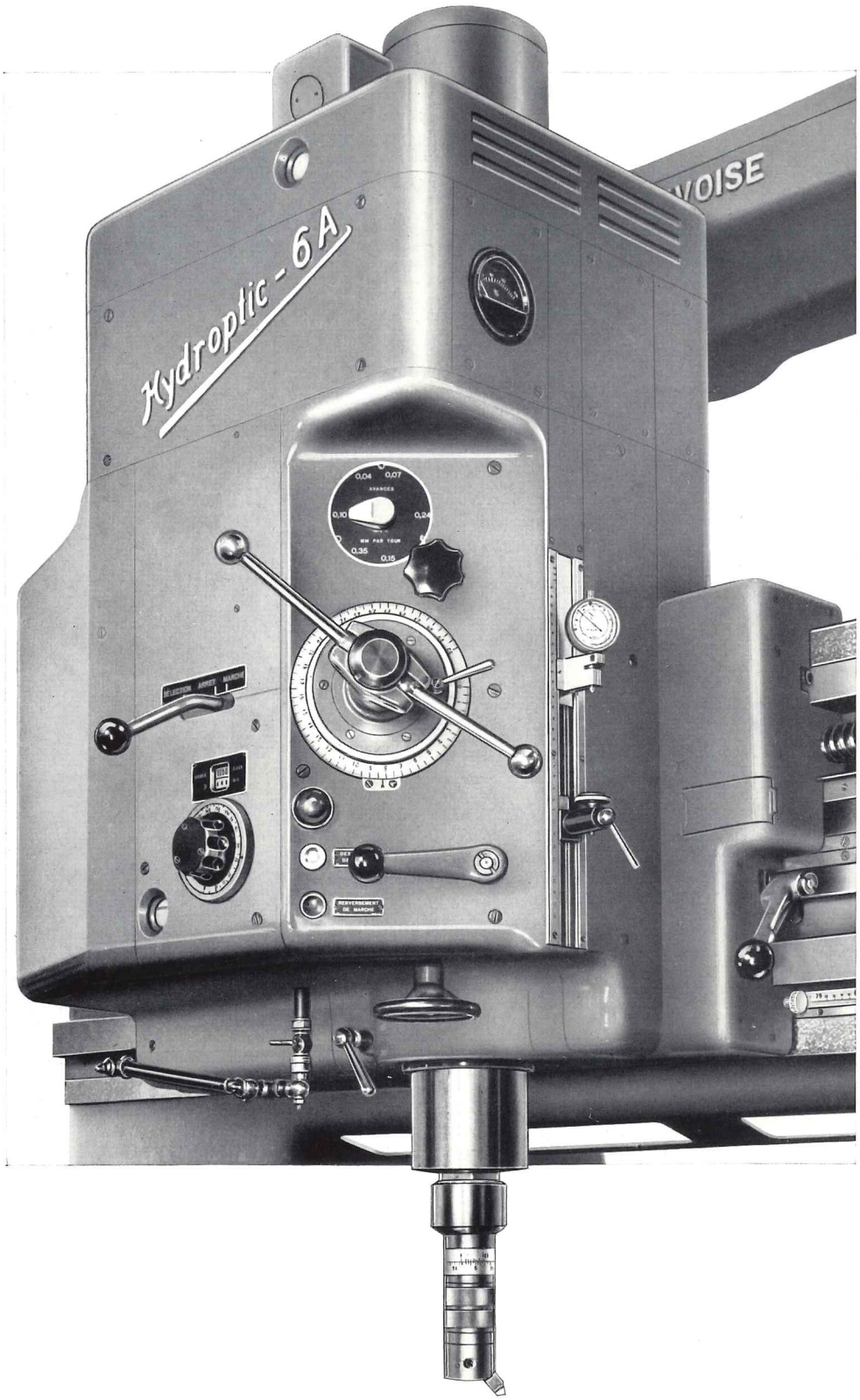
of SIP manufacture

ensuring powerful milling without detriment to the highest precision in boring

Constructional Features

A powerful spindle head

- 8 HP spindle drive motor
- exceptionally wide spindle head saddle
- large diameter spindle and quill
- unprecedented cutting ability
- preselection of spindle speeds
- automatic tool clamping and releasing
- built-in depth measuring device for use with gauge blocks

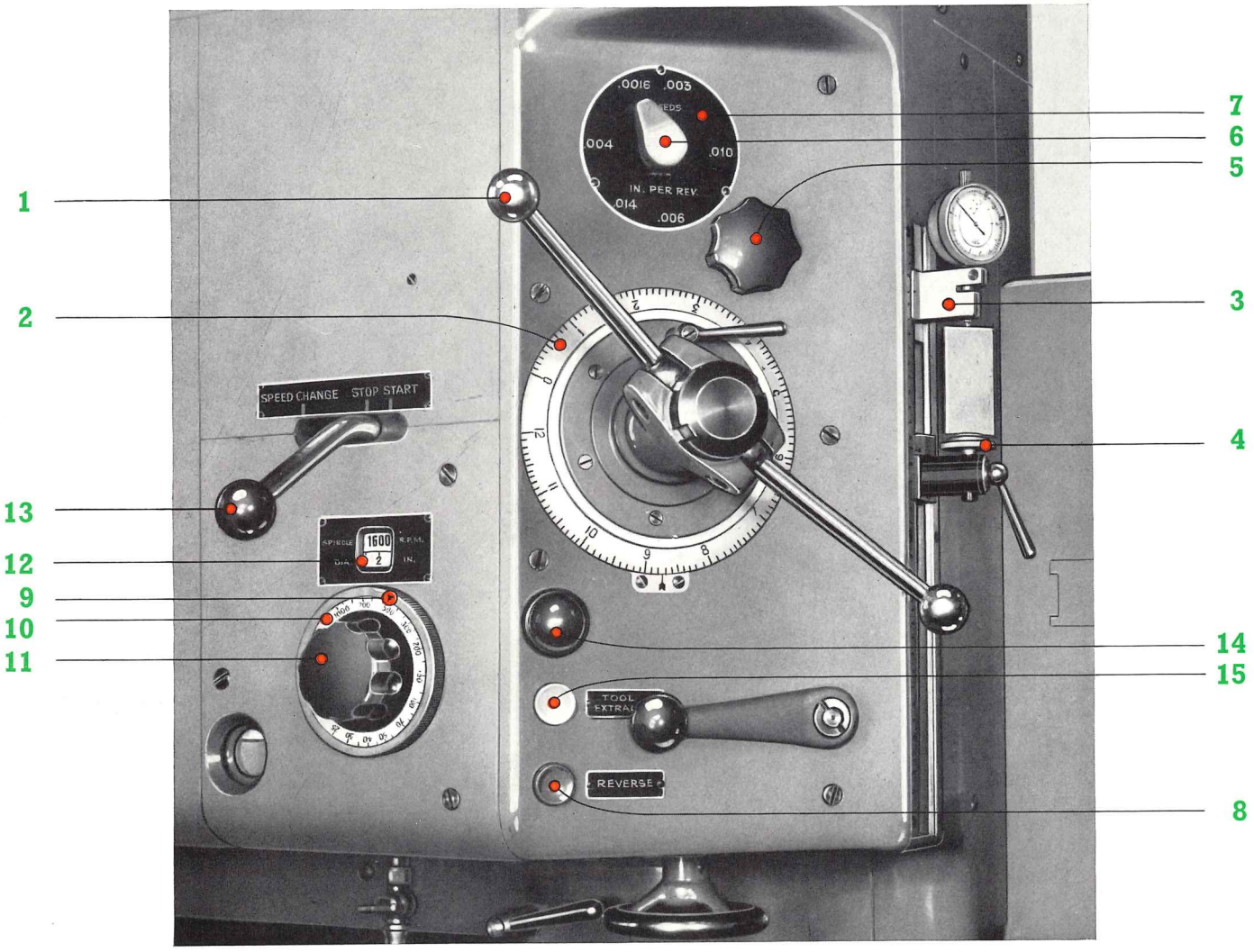


Greater strength and rigidity for faster stock removal

Centralized controls

Push-and-pull levers (1) provide for rapid spindle traverse and serve to engage the power feed which is automatically tripped at any predetermined point by simply setting the large circular dial (2) to the prescribed depth.

A vertical measuring device (3) provided with a flat support (4) on which block gauges can be placed is used for accurate depth control. The feed rate is changed by operating knob (5) and read by means of index (6) on dial (7). Reverse spindle rotation is obtained by depressing push-button (8).



Preselection of spindle speeds

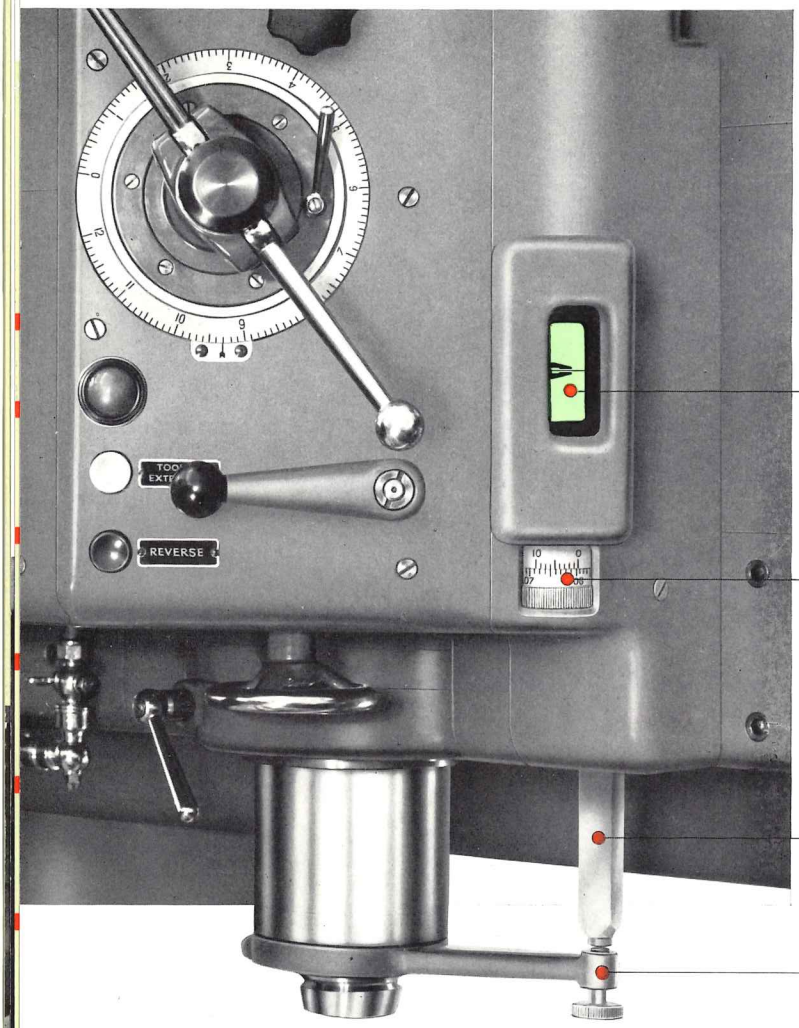
The operator first rotates the knurled ring until the index (9) is opposite the numeral corresponding to the cutting speed chosen, read on the inner graduated dial (10). By operating knob (11) he brings the value of the diameter to be bored within the window (12). The corresponding number of r.p.m. appears simultaneously. The spindle speed is then preset and can be engaged at any time by means of lever (13). All this can be done during actual machining.

Automatic tool clamping and releasing

Tools with screw clamping are automatically locked and released. Inserting them into the spindle taper causes an auxiliary motor to drive the drawbar, its action being indicated by means of the signal lamp (14). Automatic releasing is obtained by finger-tip control of the push-button (15).
This saves time and minimizes the fatigue of the operator.

Optical depth measuring device

(special accessory)



The normal depth measuring device using gauge blocks can be replaced by this special attachment which constitutes the

3rd coordinate of the machine

and incorporates the same measuring means (standard scale, screen and micrometer head) as used for table and spindle head settings.

Viewing screen

Micrometer dial, reading { 0.0001 in. / 0.001 mm.

Rod linked with standard scale

Abutment arm with screw for zero setting (starting point)

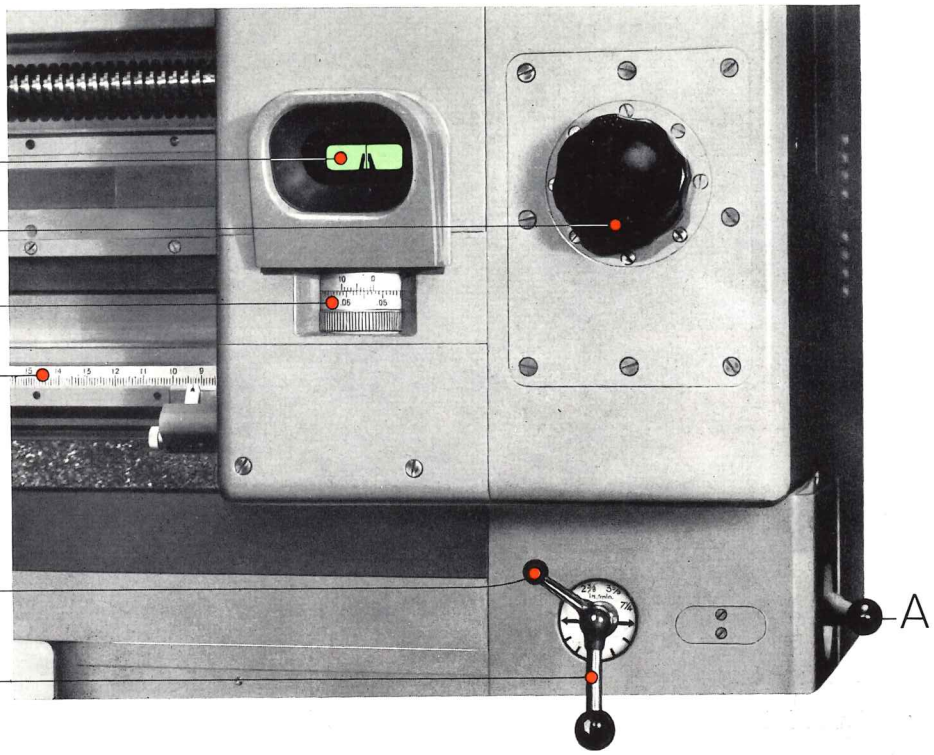
Centralized lubrication

A high pressure pump, hand driven by means of a lever located at the rear of the machine ensures the lubrication of the sliding surfaces between spindle head saddle, cross-rail and uprights. Visual check of effective lubrication is provided: A lamp controlled by manometric switches lights as soon as the oil pressure at the end of each circuit attains the required value. Furthermore, the flow of oil is automatically controlled at each lubricating point.

The cross-rail controls

At the right end of the cross-rail are conveniently grouped all controls for location, rapid traverse and automatic feed of the spindle head. Four power milling feeds are available.

By operating the single lever (A), the cross-rail is automatically unclamped by hydraulic jacks, vertically traversed by motor and locked on two points to both uprights by powerful springs.



Production Rates for rough machining

(approximately 70% of the maximum applicable)

Operations		Material			
		GREY IRON	SOFT STEEL	HARD STEEL	ALUMINIUM
DRILLING	Tool material	HSS	HSS	HSS	HSS
$2\,3/8$" - 60 mm. dia.	Feed per rev. of spindle	.014" - 0.35 mm.	.010" - 0.24 mm.	.010" - 0.24 mm.	.014" - 0.35 mm.
	Cutting speed per min.	40/50 ft. - 12/15 m.	70/85 ft. - 22/25 m.	60/70 ft. - 18/22 m.	130/200 ft. - 40/60 m.
BORING	Tool material	Carbide	HSS	HSS	Carbide
	Cutting speed per min.	200/270 ft. - 60/80 m.	65/100 ft. - 20/30 m.	60/85 ft. - 18/25 m.	500/825 ft. - 150/250 m.
2 in. - 50 mm. dia.	Width of cut (on dia.)	1/2" - 12 mm.	5/16" - 8 mm.	1/4" - 6 mm.	1/4" - 6 mm.
	Feed per rev. of spindle	.004" - 0.1 mm.	.004" - 0.1 mm.	.004" - 0.1 mm.	.004" - 0.1 mm.
12 in. - 300 mm. dia.	Width of cut (on dia.)	3/4" - 20 mm.	5/8" - 15 mm.	1/2" - 12 mm.	1 3/16" - 30 mm.
	Feed per rev. of spindle	.004" - 0.1 mm.	.004" - 0.1 mm.	.004" - 0.1 mm.	.006" - 0.15 mm.
MILLING	Surfacing				
	Cutter head with	Carbide	Carbide	Carbide	Carbide
	Section of cut	4" × 1/4" - 100 × 6 mm.	4" × 5/16" - 100 × 5 mm.	4" × 3/16" - 100 × 5 mm.	4" × 9/32" - 100 × 7 mm.
	Feed per min.	10" - 250 mm.	8 5/8" - 220 mm.	8" - 200 mm.	12" - 300 mm.
	Cutting speed per min.	200 ft. - 60 m.	260 ft. - 80 m.	200 ft. - 60 m.	800/1600 ft. - 250/500 m.
	Side milling				
	Milling cutter of	HSS	HSS	HSS	HSS
	Section of cut	3/8" × 1 1/2" - 10 × 40 mm.	3/8" × 1 1/2" - 10 × 40 mm.	3/8" × 1 1/2" - 10 × 40 mm.	3/8" × 1 1/2" - 10 × 40 mm.
	Feed per min.	7" - 180 mm.	6" - 150 mm.	6" - 150 mm.	8" - 200 mm.
	Cutting speed per min.	50/65 ft. - 15/20 m.	65/80 ft. - 20/25 m.	50/65 ft. - 15/20 m.	330 ft. - 100 m.

Automatic Repeating Device DIR

The reasons which justify the application of "automation" to machine tools intended for large batch production clearly do not apply to jig boring machines.

However, as the latter are now more frequently used for the accurate machining of lots of components, it is obvious that a device which repeats successively the initial settings made during the machining of the first workpiece will be very valuable. If the operator can avoid the necessity of making repeated settings manually, he will find his task greatly simplified and will be able to employ the time thus saved for the preparation of tools, etc.

The Automatic Coordinate Repeating Device type DIR, developed and built by SIP, features extreme accuracy, high reliability and rapid operation. A particular advantage is that the operator can at all times, and during automatic setting operations, control the accuracy of the position of the table and of the spindle head saddle by observing the index marks on the auxiliary scales, the micrometer dials and the projection screens.

Precision

When developing the DIR Automatic Repeating Device, SIP has maintained the fundamental setting principle which determines the precision of their optical Jig Borers, i.e.

direct readings on the standard scales

built into the work-table and the spindle head saddle, these readings being made with the DIR device by means of a photo-electric microscope of SIP manufacture.

The accuracy of repetition is within 0.00004 in. (0.001 mm.),

that is to say, it does not lessen the working accuracy of the machine.

Reliability

The operator is able to check constantly the precision of the automatic settings by verifying the centring of the image of the standard scale line within the indexes on the projection screens just as for manual settings.

He can always stop or restart the automatic setting cycle without influencing the final positioning accuracy.

Speed

Registering both coordinates is done instantly by pressing the push-button "RECORD". The automatic feed movements of the table and the spindle head saddle are fast and, consequently, the settings are rapidly made. To ensure the high setting accuracy, the speed is automatically slowed down when the prescribed position is approached.

Efficiency

Saving in overall production times by using the DIR device varies **between 8% and 20%** according to the kind and the number of workpieces to be machined.

Construction

A control console of compact design, easy to manipulate, contains all the electronics for recording the settings and transmitting them to the machine in connection with control transformers (synchros) incorporated in the machine and relays housed in the electric switchgear cabinet.

The DIR Device enables 40 table positions and 40 spindle head saddle positions to be repeated as often as required. It is thus possible to repeat a number of settings higher than 40 according to how many of them have a common coordinate.

Recording

Recording is obtained by storing electrical impulses on rotary interchangeable drum memories which permit any registered setting to be repeated at will without it being necessary to follow a pre-established sequence.

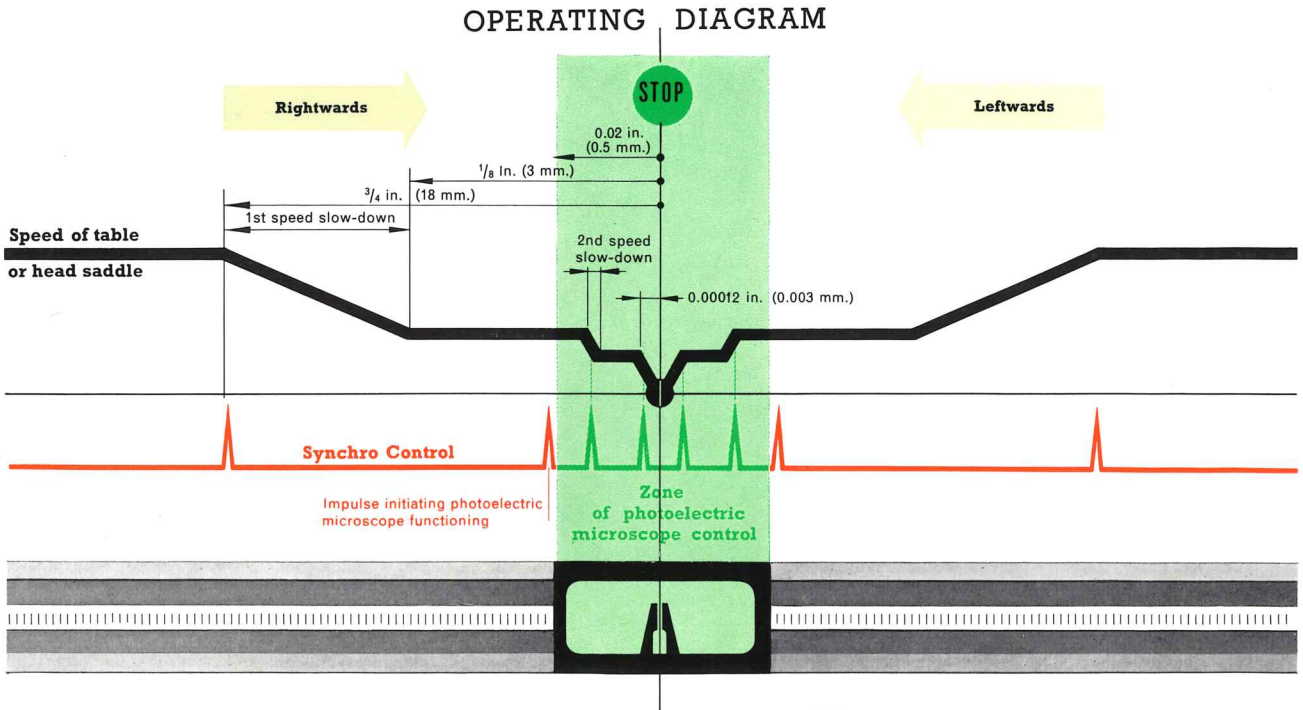
In the course of the machining of the first component of a batch, the operator, who has at his disposal a 40-position selector for each coordinate axis, registers the coordinates of each setting by pressing the push-button "RECORD".

Repetition

The operator places the selectors in position and then presses the push-button "REPEAT".

The micrometer dials rotate simultaneously and, in a few seconds, set on the recorded position. The operator engages the feed movement of the table and the spindle head saddle in the direction indicated by illuminated arrows located close to the selector levers.

Subsequent operations (the gradual reduction of the traversing speed, and the stopping of the moving unit by means of the photo-electric microscope) are then carried out automatically and without requiring any attention from the operator.



Working Flexibility of the DIR Device

The DIR device can be used for milling as well as for boring. **No movement takes place beyond the distance prescribed** so that blind slots and keyways can be milled automatically.

The spacing of two settings can be as small as a few ten-thousandths of an inch (a few thousandths of a millimeter).

The automatic repetition of the settings of both the table and the spindle head movements can be made in either direction. The table and the spindle head can be traversed while the operator is changing the tool.

The operation of the automatic stop is independent of the feed rate of the moving unit. The operator can, for example, apply the speed required for the milling operation which is in progress as soon as he initiates the movement.

Moreover, manual settings can always be made without interfering with the positions already registered.

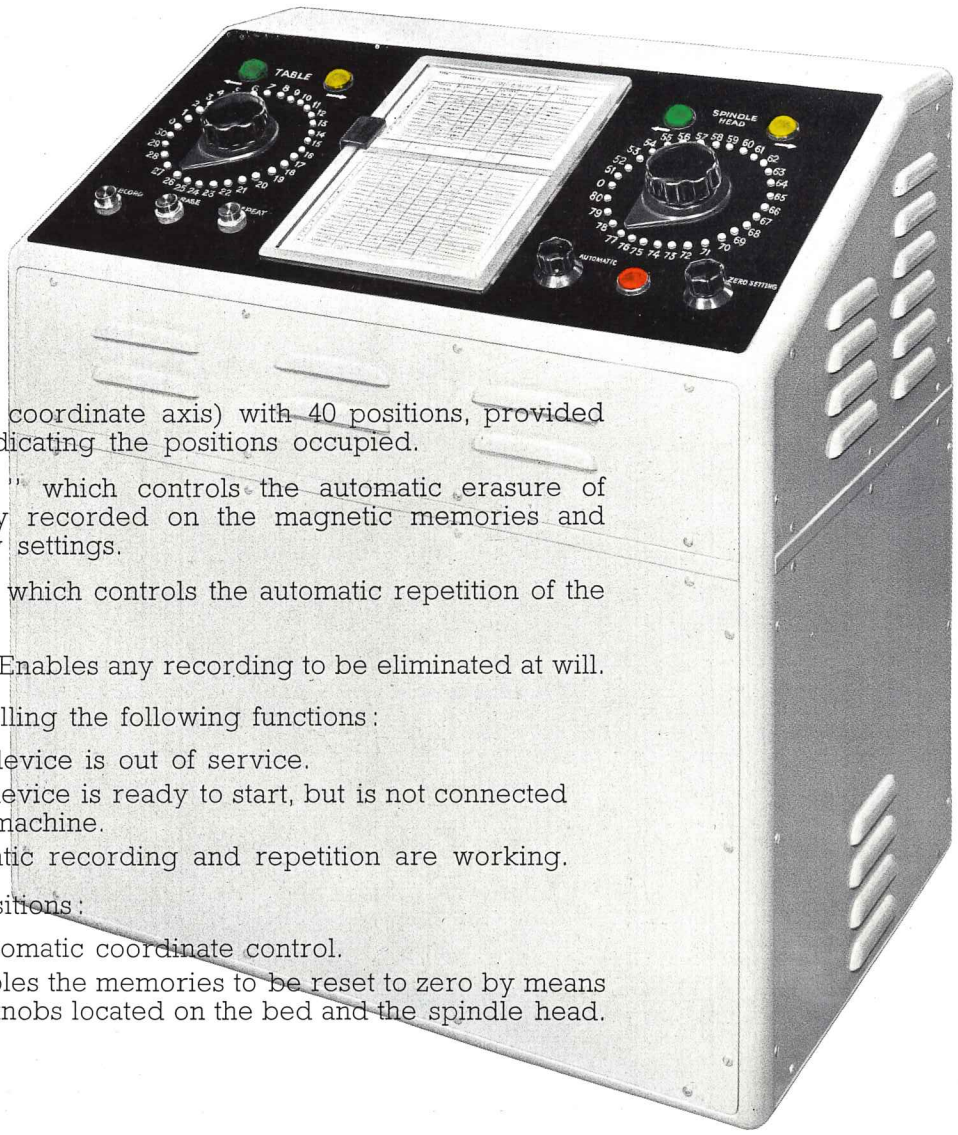
The origin of the coordinate system, which may have to be slightly modified in the course of the successive set-ups of similar components, is easily carried out as follows:

Using the knob for zero setting, the image of the standard scale line is centred between the indexes on the screen. The magnetic memories are similarly set to zero by means of a knob, the direction for final setting being indicated by illuminated arrows which also show by their simultaneous extinction the point of perfect coincidence.

The drum memories are detachable and can be stored for further use.

Changing them requires a few minutes only.

Control panel



This comprises:

Two selectors (one for each coordinate axis) with 40 positions, provided with illuminated signals indicating the positions occupied.

One push-button "RECORD" which controls the automatic erasure of the coordinates previously recorded on the magnetic memories and the registering of the new settings.

One push-button "REPEAT" which controls the automatic repetition of the registered coordinates.

One push-button "ERASE". Enables any recording to be eliminated at will.

One three-way switch controlling the following functions:

1. "MANUAL". The DIR device is out of service.
2. "HEATING". The DIR device is ready to start, but is not connected to the machine.
3. "AUTOMATIC". Automatic recording and repetition are working.

One two-way switch with positions:

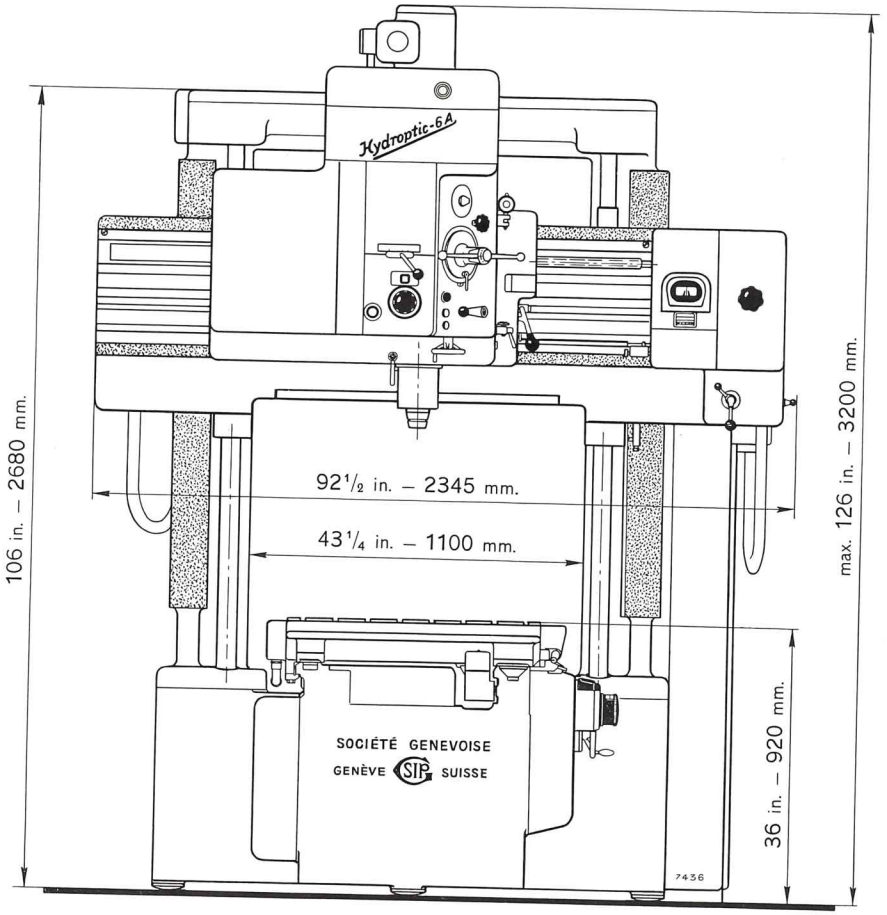
1. "WORK". For automatic coordinate control.
2. "ZERO SETTING". Enables the memories to be reset to zero by means of the knobs located on the bed and the spindle head.

Xydroptic-6A
SOCIETE GENEVOISE
GENEVE SIP SUISSE
MADE IN SWITZERLAND
Rotoptic

Hydroptic 6A

built for

Speed
Power
Precision
Reliability



Specification

Working Range

Nominal table travel	**40 in. - 1000 mm.**
Nominal spindle head travel	**28 in. - 700 mm.**
Distance from table top to spindle end (spindle retracted) max.	**39 1/4 in. - 1000 mm.**
min.	7 5/8 in. - 195 mm.
Free space between uprights	43 1/4 in. - 1100 mm.

Measuring Devices

Graduation of built-in standard scales		0.1 in. - 1 mm.
Reading on external auxiliary scales		0.1 in. - 1 mm.
Reading on micrometer heads of screens	dial	0.001 in. - 0.01 mm.
	vernier	0.0001 in. - 0.001 mm.
Spindle depth measuring device	measuring range	12 in. - 300 mm.
	reading on dial	0.0005 in. - 0.01 mm.

Work-Table

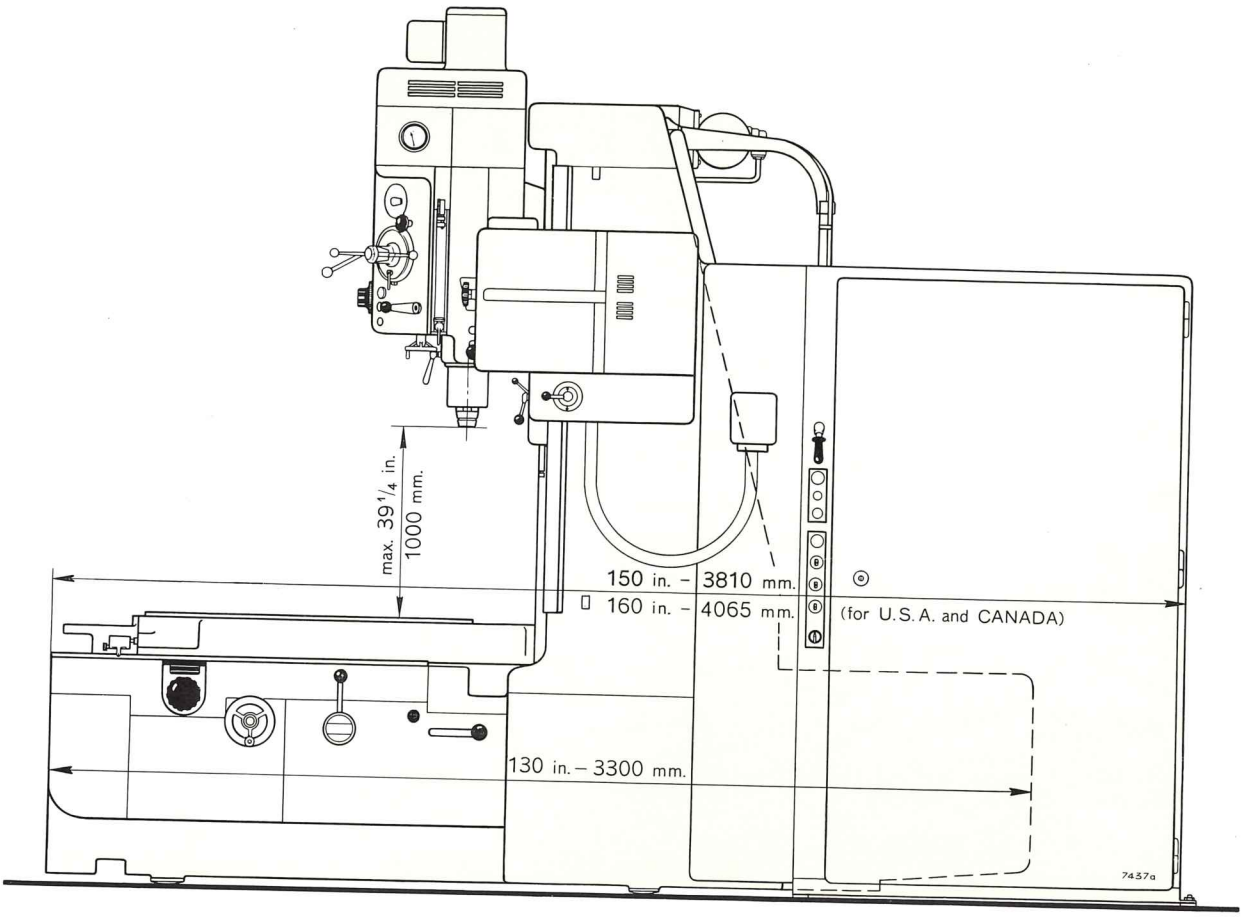
Working surface	43 1/4 × 33 in. - 1100 × 842 mm.
Width of T-slots	0.63 in. - 16 mm.
Fine hand setting	0.0055 in. - 0.14 mm/rev.
Hydraulic feeds for milling, up to	20 in. - 500 mm/min.
for rapid traverse	100 in. - 2500 mm/min. *

Spindle Head

Rapid power traverse	60 in. - 1500 mm/min. *
Fine hand setting	0.02 in. - 0.5 mm/rev.
Automatic milling feeds in each direction	1 1/8 - 2 3/8 - 3 5/8 - 7 1/4 in./min. *
	30 - 60 - 90 - 180 mm/min.

* Value for 50-cycle current. Increased by 20% for 60-cycle current.

Guaranteed Accuracy **for all displacements of the work-table**



Spindle

Driving motor	8 HP
Quill diameter	$5\,^{5}/_{16}$ in. - 135 mm.
Internal clamping taper	Morse No. 4
External clamping taper	SIP 4e (DIN 2201)
Working speeds	40 - 52 - 65 - 80 - 105 - 130 - 160 - 205 - 250 - 320 410 - 500 - 625 - 800 - 1000 - 1250 - 1600 - 2000 r.p.m.
Power feeds	0.0016 - 0.003 - 0.004 - 0.006 - 0.010 - 0.014 in./rev. 0.04 - 0.07 - 0.10 - 0.15 - 0.24 - 0.35 mm/rev.
Spindle quill traverse	**12 in. - 300 mm.**
Drilling capacity from the solid	dia. $2\,^{3}/_{8}$ in. - 60 mm.
Boring capacity	dia. 12 in. - 300 mm.
Milling capacity	cast iron (feed 10 in. - 250 mm/min.) $4 \times {}^{1}/_{4}$ in. - 100×6 mm. steel (feed $8\,^{5}/_{8}$ in. - 220 mm/min.) $4 \times {}^{3}/_{16}$ in. - 100×5 mm. alum. (feed 12 in. - 300 mm/min.) $4 \times {}^{9}/_{32}$ in. - 100×7 mm.

Weights and Packing Material

Net weight of machine with regular equipment	approx. 19,000 lbs. approx. 8 600 kg.
Gross weight (overseas boxing material)	approx. 25,000 lbs. approx. 11 300 kg.
Dimensions of machine box	154 × 110 × 114 in. 3.90 × 2.80 × 2.90 m.
Total cubic measurement of boxes	1150 cu. feet - 32m³
DIR Repeating device	net weight: 900 lbs. / 400 kg. gross weight: 1,330 lbs. / 600 kg.
Total cubic measurement with DIR	1220 cu. feet 34 m³

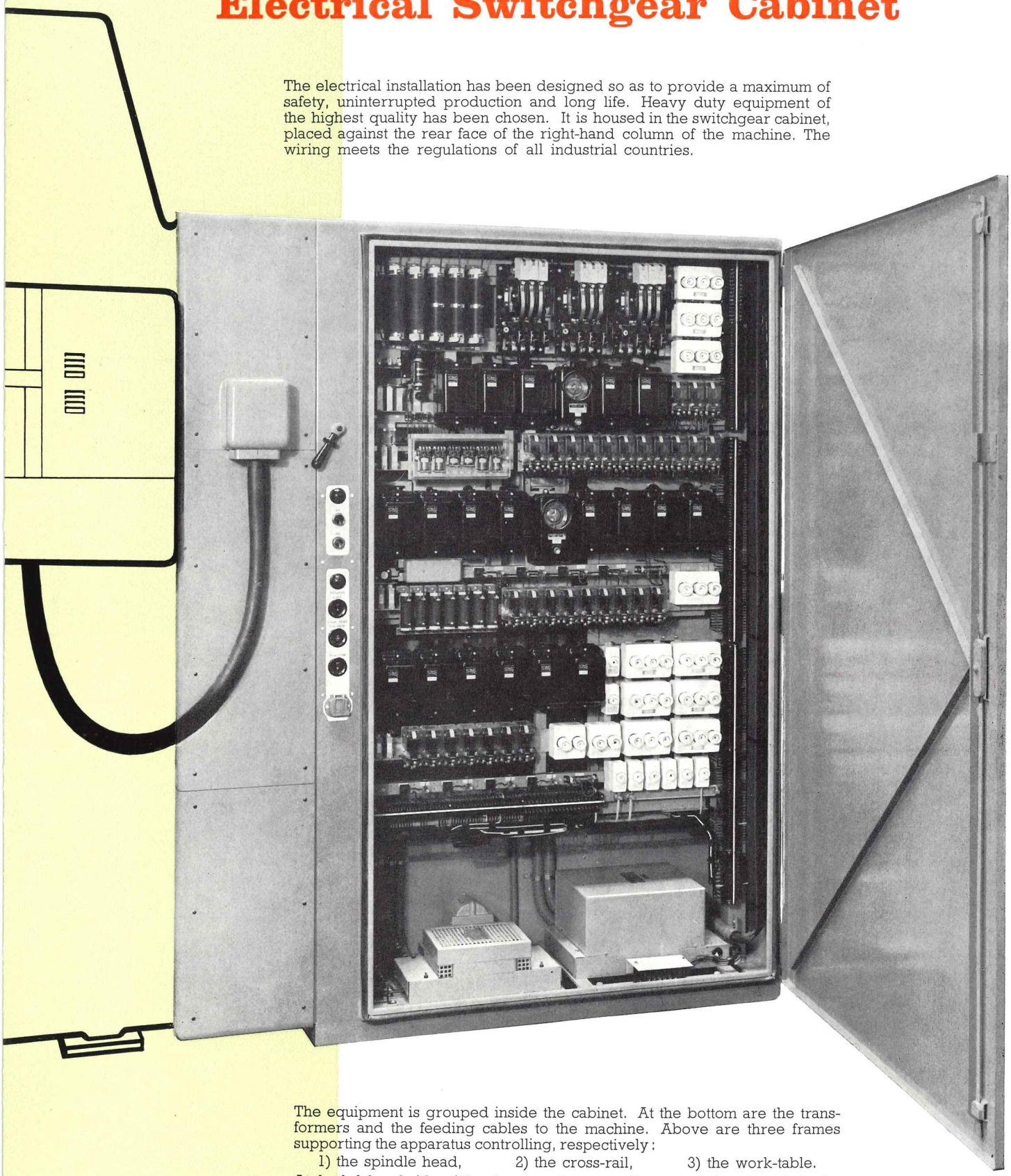
Code words

Machine with regular equipment	English **HYSIE** Metric **HYSIA**
Machine supplied with DIR Repeating device	English **HYDIR** Metric **HYDAR**

e and spindle head saddle: **0.00015 in. - 0.003 mm.**

Electrical Switchgear Cabinet

The electrical installation has been designed so as to provide a maximum of safety, uninterrupted production and long life. Heavy duty equipment of the highest quality has been chosen. It is housed in the switchgear cabinet, placed against the rear face of the right-hand column of the machine. The wiring meets the regulations of all industrial countries.



The equipment is grouped inside the cabinet. At the bottom are the transformers and the feeding cables to the machine. Above are three frames supporting the apparatus controlling, respectively:

1) the spindle head, 2) the cross-rail, 3) the work-table.

At the left-hand side of the door are the manually-operated main switch, the switches controlling the coolant pump and the illumination of the measuring devices, as well as a socket for a portable lamp.

The door of the cabinet is interlocked for safety with the main switch and can only be opened when the switch is in the " off " position. Inspection of the electrical equipment is therefore entirely safe.

Two different types of cabinets are supplied according to the frequency of the current available (50 or 60 cycles).

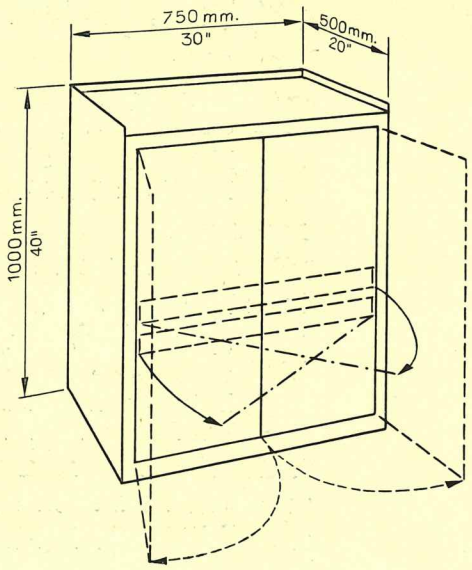
Regular Equipment

Tool cabinet

The regular equipment of the Hydroptic-6A includes a set of accessories enabling the usual setting, measuring and boring operations to be carried out most accurately and rapidly.

It is supplied in a bench-type tool cabinet specially designed for safe and handy storage which contributes to reducing the time spent for tool changes.

Provision is made to accommodate some additional accessories.



There are seven swivelling shelves, five of which have internal felt-lined fittings for the accessories.

Permissible load per shelf : 220 lbs.-100 kg.

Regular Equipment generally purchased with the machine

1 Centre point

with No. 4 Morse taper shank for the spindle. Is mainly used in conjunction with the special centring device supplied for locating the spindle over the tilting rotary table.

1 Proving bar

1 in. (20 mm.) dia., $2\,^3/_4$ in. (70 mm.) length with No. 4 Morse taper shank for rapid location of the spindle with reference to the workpiece when a machined face can be used for this purpose.

1 Three-jaw drill chuck

with No. 4 Morse taper shank for accommodating twist drills with cylindrical shank up to $^1/_2$" (13 mm.) dia.

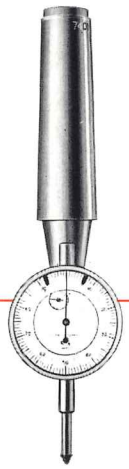
1 Locating dial indicator

with No. 4 Morse taper shank, to be mounted into the spindle with which it can move and revolve.

Mainly used for:

- Centring the spindle in an existing hole, aligning a machined face with one of the coordinate axes
- Checking the perpendicularity of a vertical face
- Locating the spindle axis over the centre of the circular dividing tables or centring work on them
- Measuring the distance between two holes, etc.

Reading: 0.0001 in. (0.002 mm.) per division of dial.



1 Axial indicator

with No. 4 Morse taper shank for the measurement of depths, checking the parallelism of a surface with the work-table, or measuring the distance between two horizontal faces.

Reading . . . . . 0.0005 in. (or 0.01 mm.)

1 Reduction sleeve with Morse tapers 4/2 for accommodating SIP tools with No. 2 Morse taper shank and with screw clamping (twist drills, end mill reamers, milling cutters and boring tool holders type L2).

5 Boring tool holders type L4 with No. 4 Morse taper shank

1 Boring tool holder type L4e with internal taper SIP 4e (DIN 2202)

English measures

Type and boring range, dia.	L4- $^{3}/_{4}$" to 1"	L4- $^{15}/_{16}$" to 1 $^{1}/_{4}$"	L4- 1 $^{3}/_{16}$" to 1 $^{9}/_{16}$"	L4- 1 $^{1}/_{2}$" to 2 $^{1}/_{16}$"	L4- 2" to 2 $^{7}/_{8}$"	L4e- 2 $^{3}/_{8}$" to 5"
Tools to be used	1 cutter	1 cutter	1 cutter	1 cutter	1 cutter	2 cutters
Max. boring depth	2 $^{3}/_{4}$"	3 $^{1}/_{2}$"	4 $^{1}/_{4}$"	5"	5 $^{3}/_{4}$"	6 $^{1}/_{4}$" a. 9 $^{1}/_{2}$"
Reading	0.0002"	0.0002"	0.0002"	0.0002"	0.0002"	0.0002"

Metric measures

Normally supplied with carbide tipped cutters for boring cast iron

Type and boring range, dia.	L4-19/25 mm.	L4-24/32 mm.	L4-30/40 mm	L4-38/52 mm.	L4-50/72 mm.	L4e-60/125 mm.
Tools to be used	1 cutter	1 cutter	1 cutter	1 cutter	1 cutter	2 cutters
Max. boring depth	70 mm.	90 mm.	110 mm.	130 mm.	150 mm.	160 and 240 mm.
Reading	0.005 mm.	0.005 mm.	0.005 mm.	0.005 mm.	0.005 mm.	0.005 mm.

These tool holders, of rigid design and perfect balancing, ensure an exceptionally high finish of the holes machined. Setting is effected by rotating the knurled ring controlling the cutter advance, the variation in diameter being read on the vernier of the circular graduation. This permits to secure large savings in time by eliminating all necessity for checking and re-checking the holes. After having bored a hole slightly undersize and gauged it, the operator re-sets the tool holder and is able then to reach in the next cut the prescribed diameter.

Boring tool holder type K4e

short type

with internal taper SIP 4e.

Boring capacity: 3 $^{3}/_{8}$" to 6 $^{1}/_{4}$" (85/160 mm.).

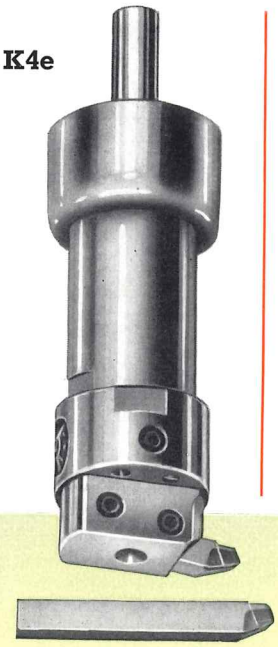
Depth range:

From 3 $^{3}/_{8}$" to 4" dia. (85 to 100 mm.): 7 $^{1}/_{4}$" (185 mm.)

Above 4" dia. (100 mm.): The full quill travel.

Reading: 0.0005" or 0.01 mm.

Supplied with 2 carbide tipped cutters for boring cast iron.



Boring tool holder type R4e

with internal taper SIP 4e.

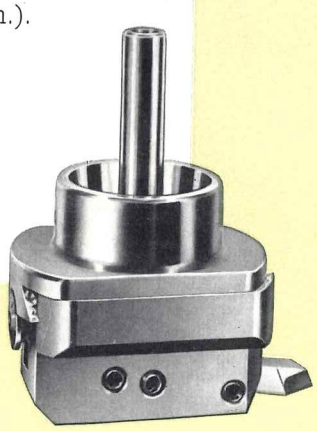
Boring capacity: 5 $^{1}/_{2}$" to 12" (140/300 mm.).

Depth range: The full quill travel.

Reading: 0.0005" (0.01 mm.).

The transversal slide is bored 1" dia. (25 mm.) H7 so as to permit boring bars to be accommodated.

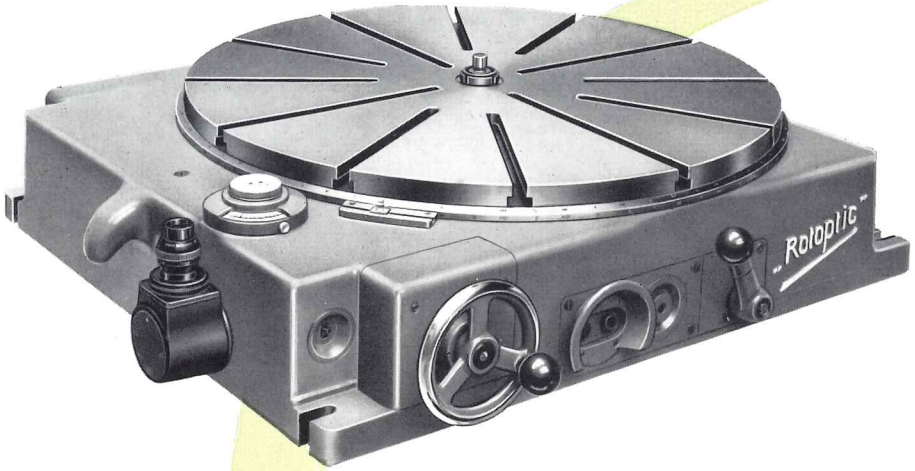
Supplied with 1 carbide tipped cutter for boring cast iron.



Additional Equipment

Automatic repeating device DIR (see pages 12, 13, 14)

Optical depth measuring device (see page 10)



The SIP Dividing Tables are most useful accessories for the Jig Borer. They provide a means of machining jigs and workpieces laid out in polar dimensions and also save much time in aligning medium-size work dimensioned in rectangular coordinates.
They are designed to withstand heavy transversal stresses due to intensive milling work. Provided with flat bases, they can be placed anywhere on the table of the machine.

Optical dividing table

Type « Rotoptic » (PD-6H) with settings on built-in master circle

Of robust design, this large optical dividing table allows heavy and cumbersome work to be easily handled.
Rapid approximate indexing is made to 10 minutes of arc with the naked eye on the graduated bevelled edge of the motor-driven platen. Final readings to 1 second of arc are obtained by setting a dial with vernier to the prescribed value and by rotating the platen by means of a slow motion handwheel until the image of one of the lines of the built-in master circle observed in the microscope is centred within the double line of the reticle.

Working surface dia. . 31 1/2 in. - 800 mm.
Total height . . . . . 7 7/8 in. - 225 mm.
Normal permissible load when used on Hydroptic-6A { 1,100 lbs. / 500 kg.
Guaranteed setting accuracy: 4 seconds of arc
Net weight . . . . . 1,100 lbs. - 500 kg.
Gross weight . . . . 1,325 lbs. - 600 kg.
Code word . . . . . ROTOP

Special equipment

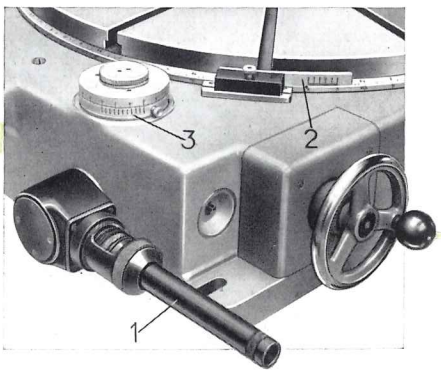
This equipment permits readings to be made when handling workpieces the diameter of which exceeds by far that of the circular table. It comprises:

1 extension optical tube (1) fitting on the normal eye-piece of the microscope,

1 indexing division (2) for approximate positioning of the platen, reading: 10 min. of arc,

1 vertical dial (3) with vernier, to be mounted on the normal bevelled dial, reading: 1 sec. of arc.

Net weight 8 lbs. - 3.5 kg. Packed 13 lbs. - 6 kg.
Code word . . . . . LUNRA



Circular dividing table Type PD-6

with settings by means of worm and wormwheel

This table has the same diameter as the optical table « Rotoptic » described in the preceding page. The platen is driven by a worm which can be instantly disengaged. It rotates, like that of the « Rotoptic », on special large ball bearing permitting easy and rapid hand rotation when large angular movements are required and for centring purposes.
Approximate indexing to 1 degree is made on the outer graduation of the platen and final readings to 1 second of arc are made on the vernier of the dial keyed to the worm shaft.

Working surface dia.	31 1/2 in. - 800 mm.
Total height	7 7/8 in. - 200 mm.
Normal permissible load when used on Hydroptic-6A . . .	1,100 lbs. / 500 kg.
Guaranteed setting accuracy	8 seconds of arc
Net weight . . .	950 lbs. - 430 kg.
Gross weight . .	1,135 lbs. - 515 kg.
Code word	DISIX

Indexing attachment

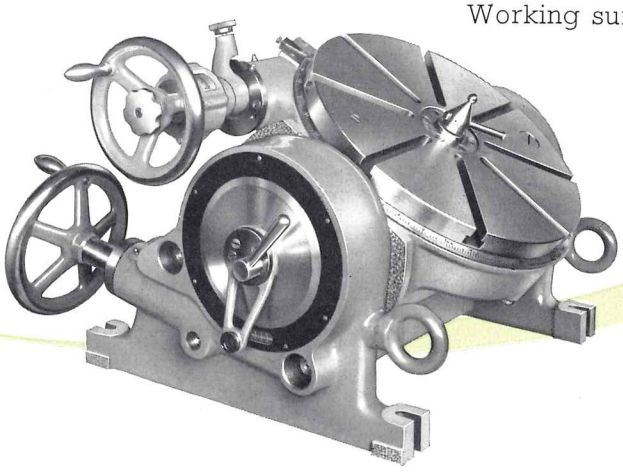
Can be readily mounted on the Circular Table PD-6 as well as on the Tilting Table PI-5.
It provides for laying out any number of holes from 2 to 100 in a circle (and other by combinations of the indexing plates) without it being necessary to take readings on the divided drum.

Net weight: 15 lbs. - 7 kg. Gross weight: 22 lbs. - 10 kg.
Code word . . . . . INDEX

Tilting rotary table Type PI-5

with settings by means of worm and wormwheel

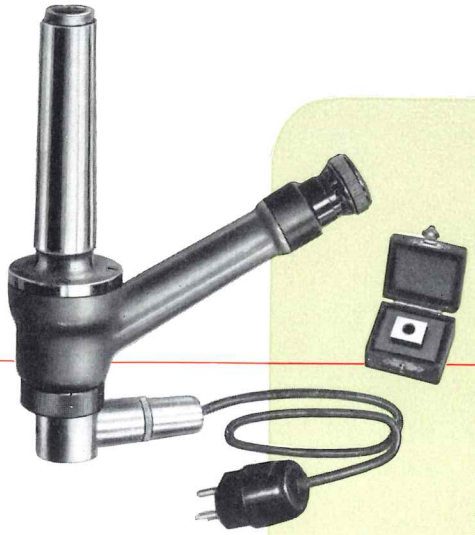
Working surface, dia. 17 3/4 in. - 450 mm.



This table permits of boring holes and milling faces oblique or at right angles, and of machining **at one set-up** all faces of a workpiece, with the exception of the clamping face. And this at a speed and within limits of accuracy which cannot be attained by any other means.

Table height (horizontal position) . . . . . 15 5/8 in. - 400 mm.
Height of centre (swing), vertical position . 10 in. - 250 mm.
Net weight. . 770 lbs. - 350 kg. Gross weight. 970 lbs. - 440 kg.
Code word . . . . . INFIV

Additional Equipment (continued)



Locating microscope

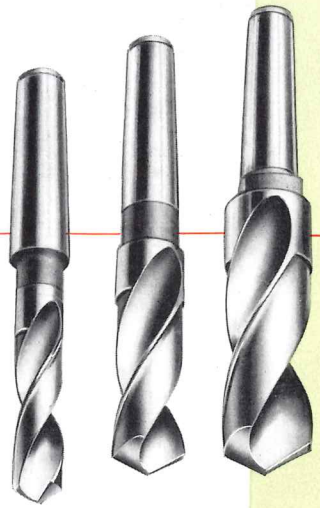
fitting in the spindle taper, for the accurate centring of the spindle over the edge of a workpiece, on a line or a punch mark. Supplied with a **reference square** for locating irregular or rounded-off edges.

Code word . . . . . LOCMI

Spotting tool

with semi-automatic, spring-operated punching point, used for laying out rapidly work to be done on other machines, scribing the outline of dies, cams, gauges, templates, etc.

Code word . . . . . SPOTO

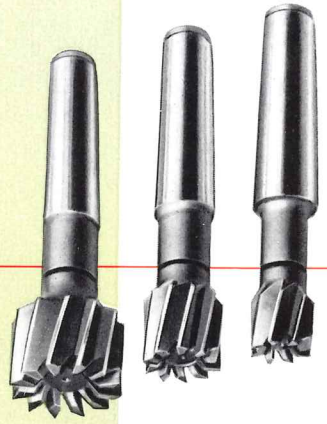


SIP Twist drills

of high speed steel with cylindrical or Nos. 1, 2 and 4 Morse taper shank. For rough drilling holes with maximum speed and accuracy.
Diameters from 0.08 to 2.315 in. (2.1 to 58.5 mm.)

SIP End mill reamers

of special carbon steel with cylindrical or Nos. 1, 2 and 4 Morse taper shank, for sizing holes of standard diameters from 0.10 to 2 3/8 in. (2.5 to 60 mm.) in one operation.



Reduction sleeves

(with clamping screw and spanner) for holding SIP tools

Morse tapers 4/1
Code word . . . . . REDUN

Morse tapers 4/2
Code word . . . . . REDEU

Clamping sleeve

(with clamping screw and spanner) with external Morse taper No. 4 and internal nose taper, for spring collets up to 1/2 in. (12 mm.) dia. capacity.

Code word . . . . . DOUFI

Extension sockets

with tapers SIP 4e/Morse No. 4 for accommodating boring tool holders type L4 (five models).

Reduction sleeves

with keyway for tools with tanged shank

Morse tapers 4/1
Code word . . . . . REDKI

Morse tapers 4/2
Code word . . . . . REDKE

Morse tapers 4/3
Code word . . . . . REDKA

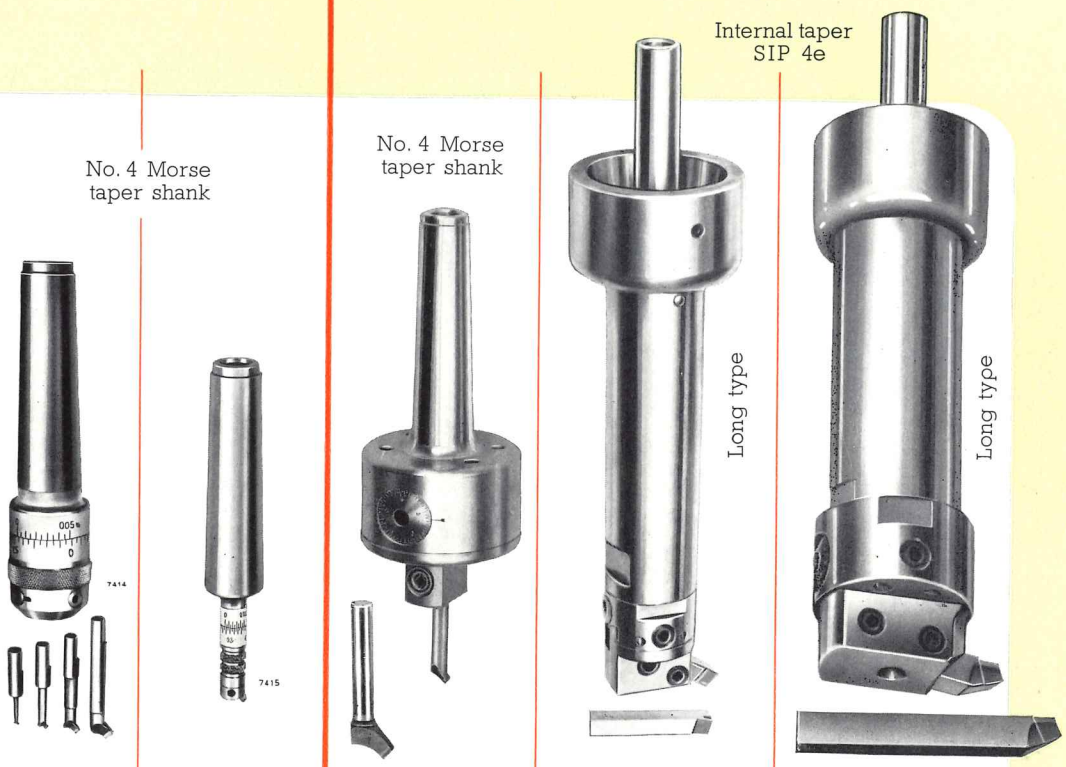
Spring collets

1/8 to 1/2 in. dia. (2.5 to 12 mm.), increasing by increments of 1/32 in. (0.5 mm.), for clamping tools with straight shank.

Code word . . . . . COLET

Adjustable boring tool holders

Special boring tool holders
for deep holes



English measures					
Type and range, dia.	L4-$^1/_8$" to $^{13}/_{16}$"	L4-$^5/_8$" to $^{13}/_{16}$"	B4-$^1/_2$" to 2 $^7/_{16}$"	G4e-2 $^3/_8$" to 4 $^3/_8$"	K4e-3 $^3/_8$" to 6 $^1/_4$"
Max. boring depth	$^1/_2$" to 1 $^1/_2$"	2 $^1/_8$"	3"	10"	10"
Reading on vernier	0.0002"	0.0004"	0.0005"	0.0005"	0.0005"
Code words	LINEA	LINEE	BEFOR	GEFOR	KAFOR
Metric measures					
Type and range, dia.	L4-3/20 mm.	L4-15/20 mm.	B4-14/62 mm.	G4e-60/110 mm.	K4e-85/160 mm.
Max. boring depth	12 to 40 mm.	55 mm.	75 mm.	250 mm.	250 mm.
Reading on vernier	0.005 mm.	0.01 mm.	0.01 mm.	0.01 mm.	0.01 mm.
Code words	LIENA	LIENE	BECAT	GECAT	KACAT

Additional cutters for boring and countersinking (see special Data Sheet)

Facing tool holder Type P4e, for facing, turning, grooving, counterboring, chambering, etc. with internal taper SIP 4e fitting the nose of the spindle. Rugged and rigid construction providing first-grade finish of the machined surfaces flat to within 0.0002 in. (0.005 mm.) on 14 in. (360 mm.) diameter.

Facing capacity:

	Diameter
Short slide (special accessory)	0 to 3" - 0 to 75 mm.
	2 to 5 $^1/_2$" - 50 to 140 mm.
Medium slide (regular equipment)	0 to 8 $^5/_8$" - 0 to 220 mm.
	1 $^3/_4$ to 9 $^3/_4$" - 45 to 250 mm.
Long slide (regular equipment)	0 to 12 $^1/_4$" - 0 to 310 mm.
	2 to 14 $^1/_8$" - 50 to 360 mm.
2 radial feeds in each direction	0.003 and 0.006 in./rev.
	0.075 and 0.15 mm./rev.
Largest diameter of tool holder body	5 $^1/_8$" - 135 mm.

Code words: English units . . . . POPLA
Metric units . . . . . PLAPO

For full data, see special Data Sheet.

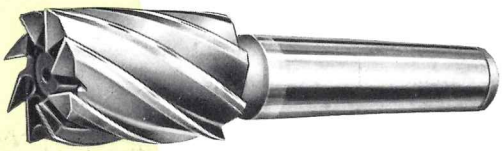
Additional Equipment (continued)

Slot and surfacing cutters

for cast iron, steel and light alloys

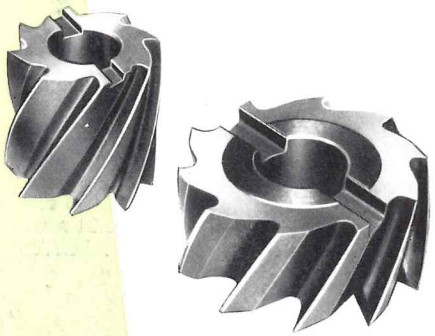
Milling cutters with No. 2 Morse taper shank

	English	Metric
diameter . . D =	$^5/_{16}$" - $^3/_8$" - $^1/_2$" - $^5/_8$"	8 - 10 - 12 - 15 mm.
length . . . L =	$^3/_4$" - $^7/_8$" - 1" - 1"	20 - 22 - 25 - 25 mm.



Milling cutters with No. 4 Morse taper shank

diameter D =	English	$^3/_8$" - $^1/_2$" - $^5/_8$" - $^3/_4$" - 1" - 1$^1/_4$" - 1$^3/_8$" - 1$^1/_2$"
length . . L =		$^7/_8$" - 1" - 1$^1/_4$" - 1$^3/_8$" - 1$^3/_4$" - 1$^3/_4$" - 1$^3/_4$" - 1$^3/_4$"
diameter D =	Metric	10 - 15 - 20 - 25 - 30 - 35 - 40 mm.
length . . L =		22 - 30 - 35 - 45 - 45 - 45 - 45 mm.



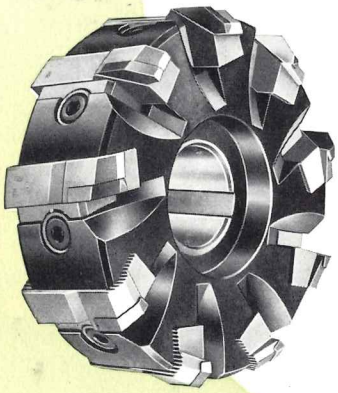
Milling cutters with cylindrical hole, to be mounted

1) on arbors with No. 4 Morse taper shank

	G.B.	U.S.A.	Metric
ext. dia. D =	2" - 2$^1/_2$"	2" - 2$^1/_2$"	50 - 60 - 75 mm.
length . L =	1$^3/_4$" - 2$^1/_4$"	1$^3/_8$" - 1$^5/_8$"	50 - 60 - 35 mm.
int. dia. d =	$^3/_4$" - 1"	$^3/_4$" - 1"	22 - 27 - 27 mm.

2) on arbors with internal taper SIP 4e

	G.B.	U.S.A.	Metric
ext. dia. D =	3" - 4"	3" - 3$^1/_2$" - 4"	90 - 110 mm.
length . L =	2$^1/_4$" - 1$^3/_4$"	1$^3/_4$" - 1$^7/_8$" - 2$^1/_4$"	40 - 40 mm.
int. dia. d =	1" - 1$^1/_8$"	1$^1/_4$" - 1$^1/_4$" - 1$^1/_2$"	32 - 40 mm.

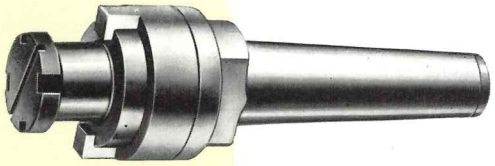


Cutter heads D = 6 in. (150 mm.)

with inserted cutters tipped with cemented carbide, to be mounted on arbor type T4e - 40/36 with internal taper SIP 4e and cylindrical end d = 40 mm., l = 36 mm.

Code words . . .	for machining cast iron (9 cutters)	FRASE
	for machining steel (6 cutters)	FRASA
	for machining light alloys (4 cutters) . . .	FRASU

Arbors with No. 4 Morse taper shank and cylindrical end



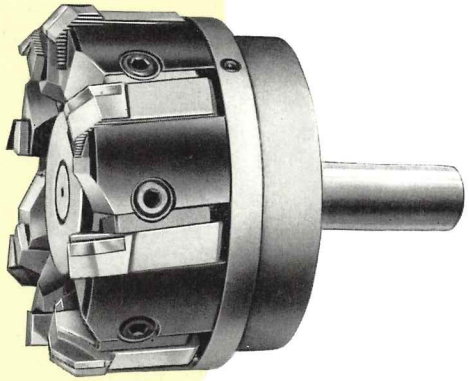
		G.B.	U.S.A.	Metric
end	dia. . . . . d =	$^3/_4$" - 1"	$^3/_4$" - 1"	22 - 27 - 27 mm.
	length . . . . l =	$1^1/_4$" - $1^5/_8$"	$^3/_4$" - $^3/_4$"	35 - 43 - 18 mm.
for cutters . . . . . D =		2" - $2^1/_2$"	2" - $2^1/_2$"	50 - 60 - 75 mm.

Arbors with internal taper SIP4e and cylindrical end

		G.B.	U.S.A.	Metric
end	dia. d =	1" - $1^1/_8$" - 40 mm.	$1^1/_4$" - $1^1/_4$" - $1^1/_2$" - 40 mm.	32 - 40 - 40 mm.
	length l =	$1^5/_8$" - $1^1/_8$" - 36 mm.	$^3/_4$" - $^3/_4$" - 1" - 36 mm.	19 - 19 - 36 mm.
for cutters D =		3" - 4" - 6"	3" - $3^1/_2$" - 4" - 6"	90 - 110 - 150 mm.

Surfacing heads D = 6 in. (150 mm.)

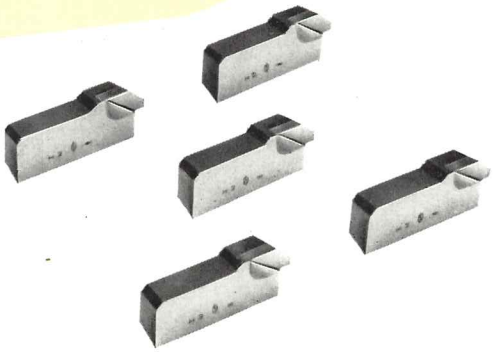
with inserted cutters tipped with cemented carbide, complete, on arbor with internal taper SIP 4e.



Code words . . . . . for machining cast iron (8 cutters) . . . TEFAT
for machining steel (6 cutters) . . . . . TEFAS
for machining light alloys (4 cutters) . . TEFAL

Spare cutters tipped with cemented carbide

Code words . . . . . for machining cast iron . . . . . COUTO
for machining steel . . . . . COUTA
for machining light alloys . . . . . COUTI



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